A Bibliography on the Greenland halibut, *Reinhardtius hippoglossoides* (a.k.a. Greenland turbot) 1936–2005

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ABSTRACT

Dyck, M.; Warkentin, P.H. and Treble, M. A. 2007. A Bibliography of Documents on *Reinhardtius hippoglossoides* (a.k.a. Greenland turbot) 1936 – 2005 Can. Tech. Rep. Fish Aquat. Sci. 2683: iv + 309 p.

This bibliography is a compilation of references for researchers and others with an interest in turbot or Greenland halibut. Approximately 1400 annotated references published between 1936 and 2005 are presented. Habitat, species identification, nomenclature and fisheries information on *Reinhardtius hippoglossoides* is provided in the introduction. The bibliography proper is presented with reference summaries given by author, and topical indices.

Keywords: bibliographies; turbot; Greenland halibut; *Reinhardtius hippoglossoides*

RÉSUMÉ

Dyck, M.; Warkentin, P.H. and Treble, M. A. 2007. A Bibliography of Documents on *Reinhardtius hippoglossoides* (a.k.a. Greenland turbot) 1936 – 2005 Can. Tech. Rep. Fish Aquat. Sci. 2683: iv + 309 p.

Cette bibliographie est une compilation de références pour les chercheurs ou autres personnes qui s'intéressent au flétan noir ou au flétan du Groenland. On y retrouve environ 1 400 références annotées publiées entre 1936 et 2005. L'introduction présente de l'information sur le *Reinhardtius hippoglossoides* concernant l'habitat, l'identification des espèces, la nomenclature et les pêches. La bibliographie indiquée est présentée avec des résumés de référence donnés par l'auteur, ainsi que par index par sujet.

Mots-clés : bibliographies; flétan noir; flétan de Groenland; *Reinhardtius hippoglossoides*

INTRODUCTION

This bibliography was prepared as a resource to assist researchers and others with an interest in the Greenland halibut (*Reinhardtius hippoglossoides*, (Walbaum, 1792)). The compilation is made up of 1417 references, the earliest dating from 1936 to 2005 year-end.

The principal focus and intent of this bibliography is to examine the nomenclature and identification of Greenland halibut and to compile an annotated reference list for this species. Several subject indexes based on the annotated bibliography have also been included.

Greenland halibut (*Reinhardtius hippoglossoides)*, is a deep-water flatfish, yellowish or grayish brown in colour. It is distributed throughout the Northeast Atlantic and the Arctic Ocean; located from England to northern Norway, Iceland and eastern Greenland. It is present in the Northwest Atlantic, from the Gulf of St. Lawrence to the deep waters off the Grand Banks of Newfoundland and north to Davis Strait and Baffin Bay and is abundant in the icy waters of the deep coastal bays and coastal shelf of eastern Baffin Island. It is also found in the northern part of the Pacific, from Sagami Bay northward, in the Sea of Japan, the Okhotsk Sea, the Bering Sea, and off the Pacific coast of North America south to Mexico (SIDP 2002 and Scott and Scott 1988).

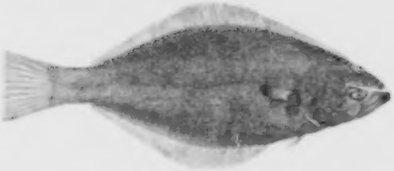

Figure 1: *Reinhardtius hippoglossoides*, illustration by Bente Olesen Nyström (Nielsen et al. 1992)

NOMENCLATURE

SCIENTIFIC NOMENCLATURES (SIDP 2002)

Pleuronectes cynoglossus (non Linnaeus) Fabricius, 1780: 163; *Pleuronectes hippoglossoides* Walbaum, 1792: 115 (original description); *Pleuronectes pinguis* Fabricius, 1824: 40; *Hippoglossus pinguis* Reinhardt, 1838: 116; *Platysomatichthys pinguis* Bleeker, 1862: 426*; Hippoglossus groenlandicus* Günther, 1862: 404*; Platysomatichthys hippoglossoides* Goode and Bean, 1879: 7; *Hippoglossus hippoglossoides* Lilljeborg, 1891: 295; *Hippoglossus (Platysomatichthys) hippoglossoides* Jensen, 1904: 271; *Reinhardtius (Platysomatichthys) hippoglossoides* Jensen, 1925: 10.

COMMON NOMENCLATURES (Scott and Scott 1988; SIDP 2002)

Danish: Hellefisk
Dutch: Groenlandse helibot, Zwarte helibot
English: Bastard halibut, Black halibut, Blue halibut, Greenland halibut, Greenland

turbot, Lesser halibut, Newfoundland turbot, Mock halibut, Turbot
Finnish: Grönlanninpallas
French: Flétan noir commun or flétan du Groenland
German: Schwarzer helibutt
Greenlandic: Qaliralik
Icelandic: Grálúpa
Inuktitut: Nataarnak
Italian: Halibut di groenlandia
Japanese: Karasugarei
Norwegian: Blakveite, svartkveite
Spanish: Fletán negro

SPECIES MISIDENTIFICATION

Turbot is a common name for Greenland halibut used within Canada. However, this can create confusion as a number of other species have also been referred to as turbot. These include *Scophthalmus aquosus* (Mitchill, 1815) (Scott and Scott 1988) and *Scophthalmus maximus* (Linnaeus, 1758) (Bauchot 1987 in FishBase 2005).

In Canada *S. aquosus* is not used commercially but is caught incidentally and considered to be 'trash fish' for use as fish meal (Scott and Scott 1988). However, in the United States it is a commercial species (Hendrickson 2000).

S. maximus belongs to the Family Bothidae which is a left-eye flounder. It is not found in the Northwest Atlantic but is harvested commercially and in sport fisheries in the Northeast Atlantic (Bauchot 1987 in FishBase 2005).

The turbot or Greenland halibut is often confused with and reciprocally misidentified with the Atlantic halibut (*Hippoglossoides hippoglossoides*). This latter species clearly is differentiated by the lateral line that is prominent and arched over the pectoral fin. The Atlantic halibut's caudal fin is also concave as opposed to square in the case of the turbot or convex in the case of the American plaice (*Hippoglossoides platessoides*).

COMMERCIAL USE AND MARKETING CONSIDERATIONS

Greenland halibut are mainly caught on long lines and by otter trawl. They are marketed fresh and frozen and are utilized dried/salted, smoked, steamed or fried. The Food and Agricultural Organization (FAO) of the United Nations has indicated that Greenland halibut's flesh is inferior to that of the Atlantic halibut (SIDP 2002) although this opinion may be disputed. The Greenland halibut stock is the largest groundfish stock in the northwest Atlantic. The average weight of Greenland halibut in the commercial catch is between 3.5 kg to 10.5 kg. The quality of its snowy white, unblemished flesh make the fillets very appealing to consumers throughout its main markets in northeastern United States and in more targeted markets in Europe and Asia (Nunavut 2002).

The name turbot, although officially adopted by Canada, is not generally used by any other country. In fact Fisheries and Oceans Canada and other Canadian agencies (FRCC

2000) still preferentially use the term Greenland halibut.

Part of the controversy and retention of the name turbot is due to a request by the Pacific halibut producers and processors in 1968 (Scott and Scott 1988). They approached the American Fisheries Society (AFS) to eliminate the word halibut from the name Greenland halibut. However, due to the broad and common entrenched international usage of the word in annual reports, bulletins and organizations (e.g. the FAO), the term "Greenland halibut" was retained. It continued to be published as such in the AFS's "List of Common and Scientific Names of Fishes". However, this species when exported from Canada to United States markets must be labeled 'Greenland Turbot' (Scott and Scott 1988).

As mentioned previously the name turbot is also used to describe other species that are marketed commercially. Turbot is a common name used to describe *S. aquosus* and in the Federal Drug Adminstration - Species Listing (FDA-SL) the market name for *S. maximus* is also Turbot. This terminology regarding *Scophthalmus* sp. may lead to confusion between Canadian "Turbot" and US "Turbot".

Greenland halibut seems to be a better and more generally used English common name for *R. hippoglossoides*, although perhaps not as commercially well-known. It is suggested that, since common naming is variable, a unique commercial nomenclature may be adopted (as was done in renaming rapeseed to canola, or the Chinese gooseberry, more commonly known as kiwifruit) and even registered as a trademark (as in the case of pharmaceutical brand names) for marketing purposes. Further, trade names need not be similar to presently used names but rather be acceptable and attractive to the consumer. However, unless export terminology can be redefined or renegotiated, the product may still have to be sublabeled 'Greenland Turbot'.

THE REGULATORY FISH ENCYCLOPEDIA (CFSAN 2003)

The U. S. Government Food and Drug Administration has established a Centre for Food Safety and Applied Nutrition and they have produced a Regulatory Fish Encyclopedia (RFE) to help federal, state, and local officials and purchasers of seafood identify species substitution and economic deception in the marketplace.

The RFE includes for each of a number of commercially relevant fish species for sale in the U.S. market high-resolution photographs (jpeg format) of whole fish and their marketed product forms (including fillets, steaks, or whole crustaceans) which may be used for visual comparison to a whole fish in question (or its marketed product form). The RFE also includes unique taxonomic characteristics (physical properties such as size, shape, color, etc.), usually in a "checklist" format, to aid in identification. In addition there is chemical taxonomic information consisting of species-characteristic biochemical patterns which may be compared quantitatively to patterns obtained by an appropriate laboratory analysis of the fish species specimen in question. These patterns include data from IEF (isoelectric focusing) and RFLP (restriction fragment length polymorphism) studies. *R. hippoglossoides* was assigned a Regulatory Fish Encyclopedia (RFE) Designation in the 2003 revision of the list (CFSAN 2005).

BIBLIOGRAPHY FORMAT

The annotated bibliography was developed based on results from a search of several sources using the key words *Reinhardtius hippoglossoides*, Greenland halibut and turbot.

References that had no identifiable author have been listed under the word [Anonymous].

References are listed in alphabetical order according to surname of the first author. References with the same first author are listed in the following order: papers with only one author are listed first in chronological order; papers with dual authorship follow and are listed in alphabetical order by the last name of the second author; and papers with three or more authors appear after the dual-authored papers and are arranged chronologically.

All citations have been verified in either primary or secondary sources.

Abstracts have been included when found.

Accents and diacritical marks have not necessarily been used and the base letters have been used on their own.

SUBJECT INDICES

In the subject listings the references are ordered alphabetically using the first author within year.

- Food, Diet and Predation
- Parasites
- Distribution
- Fisheries
- Reproduction and Development
- Age and growth

BIBLIOGRAPHIC RESOURCES

- Agricola to Nov. 2005
- Aquatic Sciences & Fisheries Abstracts (ASFA), 1978-2005
- Biological Abstracts (BIOSIS) to Nov. 2005
- Science Citation Index to Nov. 2005
- Scopus to Dec. 2005
- Waves (Fisheries and Oceans Canada libraries) to Dec. 2005

This bibliography cannot claim to be complete. As with any similar work, some items may have been overlooked.

ACKNOWLEDGEMENTS

Thanks are due to the staff of the Central and Arctic Regional Library as well as all of the other Fisheries and Oceans Libraries. A special thank-you goes to Elva Simundsson who provided invaluable assistance in the preparation of this document.

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[CFSAN] Centre for Food Safety and Applied Nutrition. 2003. The Regulatory Fish Encyclopedia. Centre for Food Safety and Applied Nutrition, Food and Drug Administration, U.S. Department of Health and Human Services. http://www.cfsan.fda.gov/cgi-bin/seafd?QUERY=reinhardtius (accessed 21 November, 2005).

Froese, R. and D. Pauly. Editors. 2005. FishBase. World Wide Web electronic publication. www.fishbase.org, (accessed 21 November, 2005.)

[FRCC] Fisheries Resource Conservation Council. 2000. Uncharted Waters: Annual Report of the Fisheries Resource Conservation Council and Conservation Requirements for Atlantic Groundfish Stocks for 2000. Fisheries Resource Conservation Council. FRCC.2000.R.5. 174 p.

Hendrickson, L. 2000. Windowpane Flounder.http://www.wh.whoi.edu/sos/spsyn/fldrs/window (accessed 26 September, 2002)

Nielsen, J. G., E. Bertelsen and B. O. Nyström (1992). Fisk i grønlandske farvande. Nuuk, Atuakkiorfik. 65 p.

Nunavut, Department of Sustainable Development, Fisheries and Sealing Division. 2002. The Fishing Industry of Nunavut : Sedna's Bounty. p.5

Scott, W. B. and M. G. Scott. 1988. Atlantic Fishes of Canada. Can. Bull. Fish. Aquat. Sci. 219: 731 p.

[SIDP] Species Identifcation and Data Programme. 2002. Species Identification Sheet. *Reinhardtius hippoglosoides* (Walbaum, 1792). Food and Agriculture Organization of the United Nations, Species Identification and Data Programme. http://www.fao.org./fi/sidp (accessed 5 April, 2006).

SPECIAL NOTE

This bibliography was created using a Reference Manager database containing documents pertaining to Greenland halibut. Many of these documents also include information regarding other species. You can obtain a CD copy of this database by contacting Margaret Treble at:

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ANNOTATED BIBLIOGRAPHY

Aadlandsvik, B., Gundersen, A.C., Nedreaas, K.H., Stene, A., and Albert, O.T. 1999. Modelling the advection and diffusion of eggs and larvae of northeast Arctic Greenland halibut. ICES CM 1999/K:03: 20 p.

In later years there has been considerable uncertainty on the recruitment of the northeast Arctic stock of Greenland halibut (*Reinhardtius hippoglossoides*). The abundance of several year classes originally considered very low at 0-3 years age, are now considered higher than expected at the age of 6 or more. A possible explanation, raised earlier, is more northeasterly than expected distribution of the young fish by active migration and/or drift of eggs and larvae. The present work considers the transport and dispersion of eggs and larvae of Greenland halibut by numerical modelling. Current fields from a 3D baroclinic hydrodynamic model are fed in to a Lagrangian particle tracking model. The particles are released into the current at the spawning field along the shelf slope from Vesteraalen to Bjoernoeya (69-75 degree N). Vertically, the particles can follow a predefined depth-by-age curve or be kept at a fixed depth. This model system is used for different years to examine changes in the drift pattern.

Aadlandsvik, B., Gundersen, A.C., Nedreaas, K.H., Stene, A., and Albert, O.T. 2004. Modelling the advection and diffusion of eggs and larvae of Greenland halibut (*Reinhardtius hippoglossoides)* in the north-east Arctic. Fish. Oceanogr. 13: 403-415.

Since the late 1980s there has been considerable uncertainty in recruitment levels of the north-east Arctic stock of Greenland halibut (*Reinhardtius hippoglossoides*). The abundance of several year classes, originally considered very low at 0-3 yr age, appeared higher than expected at the age of 6+. This may be due to poor targeting of recruitment surveys of the younger year classes. The present work considers the transport and dispersion of eggs and larvae of Greenland halibut by numerical modelling in order to predict the locations of the initial recruitment grounds. Current fields from a 3D baroclinic hydrodynamic model are fed into a Lagrangian particle-tracking model developed for the Barents Sea area. The particles are released into the current at the spawning field along the shelf slope from Lofoten to Bear Island (69-75 degree N). Vertically, the particles can follow a predefined depth-by-age curve or be kept at a fixed depth. This model system is used for different years to examine changes in the drift pattern. The results indicate that spawning location, transport depth and inflowing activity to the Barents Sea are important factors influencing the distribution of juveniles.

Aglen, A., Drevetnyak, K., Jakobsen, T., Korsbrekke, K., Lepesevich, Y., Mehl, S., Nakken, O., and Nedreaas, K. H. 2001. Investigations on demersal fish in the Barents Sea winter 2000--detailed report. IMR/PINRO Joint Rep. Ser 5: 74 p.

A combined acoustic and bottom trawl survey to obtain indices of abundance and estimates of length and weight at age has been carried out each winter (4-6 weeks in January-March) since 1981 in the Barents Sea. The target species are cod and haddock, but in recent years abundance indices have also been worked out for the redfish species and Greenland halibut. Since 1993 the survey area has been extended to the north and east in order to obtain a more complete coverage of the younger age groups of cod. In winter 1997 only the Norwegian part of the Barents Sea and a small part of the Svalbard area was covered, while in 1998 also a small part of the Russian EEZ was covered. In 1999 and 2000 the vessels had full access to the Russian EEZ.

Aglen, A., Alvsvaag, J., Lepesevich, Y., Korsbrekke, K., Mehl, S., Nedreaas, K.H., Sokolov, K., and Aagotnes, P. 2002. Investigations on demersal fish in the Barents Sea winter 2001--

Detailed report. IMR/PINRO Joint Report series 2: 65 p.

A combined acoustic and bottom trawl survey to obtain indices of abundance and estimates of length and weight at age has been carried out each winter (46 weeks in January- March) since 1981 in the Barents Sea. The target species are cod and haddock, but in recent years abundance indices have also been worked out for the redfish species and Greenland halibut. Since 1993 the survey area has been extended to the north and east in order to obtain a more complete coverage of the younger age groups of cod. In winter 1997 only the Norwegian part of the Barents Sea and a small part of the Svalbard area was covered, while in 1998 also a small part of the Russian EEZ was covered. In 1999 and 2000 the vessels had full access to the Russian EEZ. In 2001 a Russian research vessel covered most of the areas where the Norwegian vessels did not have access, and a sufficient coverage was thus obtained. The main results in 2001 were: - the 1999 year class of cod is very weak and the 2000 year class is indicated to be somewhat below average. The 1998 year class is slightly higher than expected from last years survey; - the abundance indices of 47 year old cod (1997-1994 year classes) are around average, as expected from the last years survey; - the numbers of 8 year and older cod are very low; - length and weight at age and weight increment are improving; - the mortality rate has been reduced compared with the previous years for age group 4 and younger, while it is still high for older age groups; - for haddock all the year classes 1998, 1999 and 2000 are indicated to be at or above average. The 1996 year class is below average, but considerably larger than the year classes 1992-1995, which are very weak; - length and weight at age and weight increment seem to have stabilized in 2001, after a period of increase over the years 1998-2000; - the abundance indices of the redfish species are among the lowest in the time series and there are no signs of improved recruitment; - compared to the 2000-results the abundance indices of Greenland halibut less than 40 cm have decreased, while they have increased for most of the size groups above 40 cm. The survey covers, however, only parts of this species' normal area of distribution.

Aglen, A., Alvsvaag, J., Drevetnyak, K., Høines, A., Korsbrekke, K., Mehl, S., and Sokolov, K. 2002. Investigations on demersal fish in the Barents Sea winter 2002--Detailed report. IMR/PINRO Joint Report series 6: 63 p.

A combined acoustic and bottom trawl survey to obtain indices of abundance and estimates of length and weight at age has been carried out each winter (4-6 weeks in January- March) since 1981 in the Barents Sea. The target species are cod and haddock, but in recent years abundance indices have also been worked out for the redfish species and Greenland halibut. Since 1993 the survey area has been extended to the north and east in order to obtain a more complete coverage of the younger age groups of cod. In winter 1997 only the Norwegian part of the Barents Sea and a small part of the Svalbard area was covered, while in 1998 also a small part of the Russian EEZ was covered. In 1999 and 2000 the Norwegian vessels had full access to the Russian EEZ, In 2001 and 2002 a Russian research vessel covered most of the areas where the Norwegian vessels did not have access, and a sufficient coverage was obtained. The main results in 2002 were: - the 2001 year class of cod is very weak and the 2000 year class is indicated to be somewhat below average. The 1999 and 1998 year classes is slightly higher than expected from last years survey; - the abundance indices of 5-8 year old cod (1997-1994 year classes) are as expected from the last years survey; - the numbers of 9 year and older cod are very low; - lengths and weights at age and weight increments are similar to those observed in 2001, while some increase was observed from 2000 to 2001; - the mortality rate has been reduced compared with the previous years for age group 6 and younger, while it has remained high for older age groups; - for haddock all the year classes 1998, 1999, 2000 and 2001 are indicated to be at or above average. The 1996 year class is below average, but considerably larger than the year classes 1992-1995, which are very weak; - length and weight at age and weight increment seem to have stabilized, after a period of increase over the years 1998-2000; - the abundance indices of the redfish species are among the lowest in the time series and there are no signs of unproved recruitment; - compared to the 2001-results the abundance indices of Greenland halibut in the size range 15 to 44 cm have decreased, while they have increased for the other size groups

Aglen, A., Alvsvaag, J., Halland, T.I., Høines, Å., Nakken, O., Russkikh, A., and Smirnov, O. 2003. Investigations on demersal fish in the Barents Sea winter 2003. Detailed report. IMR/PINRO Joint Report series 1: 53 p.

A combined acoustic and bottom trawl survey to obtain indices of abundance and estimates of length and weight at age has been carried out each winter (4-6 weeks in January-March) since 1981 in the Barents Sea. The target species are cod and haddock, but abundance indices have also been worked out for the redfish species since 1986 and Greenland halibut since 1990. Prior to 1993 a fixed standard area (north and east in order to obtain a more complete coverage of the younger age groups of cod. In winter 1997 only the Norwegian part of the Barents Sea and a small part of the Svalbard area was covered, while in 1998 also a small part of the Russian EEZ was covered. In 1999 and 2000 the Norwegian vessels had full access to the Russian EEZ. In the years 2001-2003 a Russian research vessel covered the areas where the Norwegian vessels did not have access.

Aglen, A., Alvsvaag, J., Høines, Å., Korsbrekke, K., Smirnov, O., and Zhukova, N. 2004. Investigations on demersal fish in the Barents Sea winter 2004. Detailed report. IMR/PINRO Joint Report series 5: 58 p.

The main results in 2004 were: - The abundance of the 2003 and 2001 year classes of cod are poor, the 2002 and 1999 year classes are below average, while the 2000 and 1998 year classes are near average. - The abundance of older cod (7 years and older) is above average. - Compared to the 2003 survey these results are more pessimistic for all the year classes 1998-2002, but more consistent for older fish. This tendency is most evident for the acoustic results. - Lengths and weights at age and weight increments are slightly less than those observed in the previous two years, for most age groups. - The survey mortality calculated from the swept area results indicates that the mortality in 2003 for age 2 and for ages 6 and older was similar to the mortality in 2002, while it has increased for the remaining age groups. - For haddock the 2003 year class appears to be below average, the 2002 year class to appears to be strong and the year classes 1998 to 2001 are indicated to be at or above average. The amount of age 7 and older is somewhat below average. - Length, and weight at age and weight increments indicate slightly reduced growth. - The abundance indices of the redfish species are among the lowest in the time series and there are no signs of improved recruitment. - Compared to the 2003-results the abundance indices of Greenland halibut for fish below 20 cm and fish in the size range 30 to 40 cm have increased slightly, while in the size range 20-30 cm and above 40 cm the indices have decreased.

Alaska Sea Grant College Program. 1995. Proceedings of the International Symposium on North Pacific Flatfish, October 26-28, 1994, Anchorage Alaska. Alaska Sea Grant College Program report. AK-SG-95-04. Wakefield fisheries symposia series. 12. 650 p.

Albert, O.T. 2001. Northeast Arctic Greenland halibut (*Reinhardtius hippoglossoides*) population structure from nursery to spawning areas. NAFO SCR documents 01/128: 14 p.

Based on 12 trawl surveys to spawning, nursery and feeding areas of Greenland halibut between October 1996 and January 1999, the paper describes the population structure of the concentrations in relation to distribution area and state of maturity. The paper considers how the migration from nursery to spawning area depends on individual characteristics, such as sex, maturity stage and previous growth history, and how emigration from nursery is linked to immigration to spawning areas. The paper also describes the age and length structure of the different maturity groups in the spawning area. It was found that for both males and females, the fast growing individuals left the nursery first, and there were no obvious sex-difference in emigration rate from the nursery area. Further, the early maturing females that are found along with those close to spawning are not representative of next years spawners, as previously suggested. Before spawning stock biomass can be realistically modelled, similar studies should also be made on the vertical component of migration and all the migration processes should be quantified.

Albert, O.T. 2003. Migration from nursery to spawning area in relation to growth and maturation of Greenland halibut (*Reinhardtius hippoglossoides*) in the Northeast Arctic. J. Northwest Atl. Fish. Sci. 31: 113-125.

The population structure of the concentrations of Greenland halibut (*Reinhardtius hippoglossoides* (Wabaum, 1792)) in relation to distribution area and state of maturity is described based on 12 trawl surveys conducted in the spawning, nursery and feeding areas along the Norwegian Continental Slope between October 1996 and January 1999. Based on these, inferences are made of how the migration from nursery to spawning area depends on individual characteristics, such as sex, maturity stage and previous growth history, and how emigration from nursery is linked to immigration to the spawning area. Descriptions are also given of the age and length structure of the different maturity groups in the spawning area. It was inferred that for both males and females, the fast growing individuals left the nursery first, and there was no obvious sex-difference in emigration rate from the nursery area. The early maturing females that are found along with those close to spawning have low growth rates and are thus not representative of all the next year's spawners, as previously suggested. Before spawning stock biomass can be realistically modelled, similar studies should also be made on the vertical component of migration and all the migration processes should be quantified.

Albert, O.T. and Høines, Å. 2003. Comparing survey and assessment data: consequences for stock evaluation of Northeast Arctic Greenland halibut. Sci. Mar. 67: 171-180.

Based on VPA-estimates of abundance, survey data and commercial catch statistics of Northeast Arctic Greenland halibut *(Reinhardtius hippoglossoides* Walbaum), the paper describes trends by year-class and age in the distribution of Greenland halibut between surveyed and not-surveyed areas. Changes in the distribution of I-group around 1990 to areas beyond the Svalbard surveys has previously been described and related to temperature changes in the Spitsbergen Current. This paper shows that this displaced distribution of the 1989-94 year-classes persisted up to age 7. The results indicate that the displacement was an extraordinary situation and other similar distribution shifts have not occurred during the last 30 years or more. Further, the shift co-occurred with extreme levels of the 137 year long time series of the index of the North-Atlantic Oscillation (NAO). The results are discussed in relation to stock management and climate change.

Albert, O.T., Nilssen, E.M., Nedreaas, K.H., and Gundersen, A.C. 1997. Recent variations in recruitment of Northeast Atlantic Greenland halibut (*Reinhardtius hippoglossoides*) in relation to physical factors. ICES CM 1997/EE:06: 22 p.

Based on annual bottom trawl surveys in the Barents Sea and Svalbard area in 1983-96, the paper describes variations in abundance and compositions of I-group Greenland halibut. The main pattern of variation in abundance during the period was a change from high abundance in the first half of the period, to low abundance in the second half. The reduced abundance was associated with a northerly shift in distribution. In the last two years the recruits reappeared, first in northern parts of the study area and then also further south. These periodical changes in juvenile distribution, may be driven by physical oceanographical processes. Distribution changes probably extend beyond the area covered by the annual surveys. Thus, the results add uncertainty to the recent assessments of the state of the stock.

Albert, O.T., Eliassen, J.E., and Høines, Å. 1998. Flatfishes of Norwegian coasts and fjords. J. Sea Res. 40: 153-171.

Bottom trawl surveys in North Norwegian fjords and coastal areas, on a South Norwegian coastal bank, and along the Russian Kola coast, are used to describe distribution, species composition, individual growth, population structure, and exploitation of plaice (*Pleuronectes platessa)*, long rough dab (*Hippoglossoides platessoides*), witch (*Glyptocephalus cynoglossus)*, lemon sole (*Microstomus kitt)*, dab (*Limanda limanda*), megrim *(Lepidorhombus whiffiagonis)*, halibut (*Hippoglossus hippoglossus*) and Greenland halibut (*Reinhardtius hippoglossoides*). Based on distribution and abundance, individual species have been grouped as northern, southern or intermediate, as shallow or deep, and as associated with fjords or with coastal banks. The four most abundant flatfishes in Norwegian coastal zones, plaice, long rough dab, witch, and lemon sole, were equally or more abundant in the north compared to the south. Specimens of these species were generally larger in the north and mean length at age tended to be lower. Possible nursery areas were indicated for plaice and lemon sole.

Albert, O.T., Nilssen, E.M., Stene, A., Gundersen, A.C., and Nedreaas, K.H. 1998. Spawning of the Barents Sea/Norwegian Sea Greenland halibut (*Reinhardtius hippoglossoides*). ICES CM 1998/O:22: 19 p.

Based on eight trawl surveys of the spawning area along the continental slope between North-Norway and Svalbard, the paper gives a preliminary description of the spawning time and spawning area of Greenland halibut (*Reinhardtius hippoglossoides)*. Spawning started in November, peaked in December and ended in late January. Mature fish arrived to the spawning area in early autumn and left during the first months of the year. Spawning occurred between 500 and 800 m in waters of approx. 2 degree C. All length groups spawned within the same period, though running males were recorded within a wider range, both bathymetrical, latitudinal and temporal. Different maturity classes were identified with frequency analyses of the Gonadosomatic Index. First-time spawners may possibly be identified more than one year before spawning. Eggs were found pelagically in December and January, probably at depth below 400m. This is the first time ever that eggs of this stock were found in the sea. Although the spawning season in this area was well defined, other observations showed that spawning also occurred half a year later in nearby areas, thus underlining the dichotomy in the literature as to the spawning time of this stock.

Albert, O.T., Midling, K., Gundersen, A., Rasmussen, T., and Siikavuopio, S. 1999. Blåkveite som forsøksdyr : Erfaringer fra innledende forsøk og perspektiver for bestandsvurderinger [Greenland halibut (*Reinhardtius hippoglossoides*) experiments : experiences from preliminary tests and perspectives for stock estimation]. Rapp. Fiskeriforsk. 14: 10 p. [In Norwegian]

Rapporten summerer opp erfaringer med a holde blakveite levende med tanke pa framtidige eksperimentelle undersoekelser. Forsoekene har dels foregatt ved Fiskeriforskning og dels ved Finnmarksforskning og Moereforskning. Arten er svaert omtalig for slitasje/skjellavskraping. Linefanget blakveite har klart bedre overlevelse enn tralfanget. Transportetappen er kritisk, det er viktig at ikke fiskene gnikker mot hverandre i sjoegang. Den kan vaere vanskelig a fa til a spise, men i ett av forsoekene spiste den fersk sild og fiskeavskjaer. Muligheten for a bruke blakveite som forsoeksdyr ser lovende ut, men det krever enda noe mer utproeving av metodikken. Bestandsvurderinger og oekologiske undersoekelser av blakveite har vist at den stoerste usikkerheten i bestandsanslagene skyldes manglende kunnskap om artens fysiologi og atferd. Flere resultater fra feltundersoekelser indikerer at forskningstoktene ikke gir representative proever av denne bestanden. Hvor godt toktene dekker ulike aldersgrupper og modningsstadier ser dessuten ut til a variere svaert mye med det fysiske miljoe. Mens feltundersoekelser kan avdekke slike moenstre, trengs det eksperimentelle studier for a kartlegge arsakssammenhengen. Uten kunnskap om arsak til disse store svingningene er det ikke mulig a framskrive bestandssituasjonen eller gjennomfoere tokt pa en palitelige mate. Eksperimentell fiskeribiologi kan derfor vaere noekkelen til bedre forvaltning av blakveite.

Albert, O.T., Nilssen, E.M., Nedreaas, K.H., and Gundersen, A.C. 2001. Distribution and abundance of juvenile Northeast Arctic Greenland halibut (*Reinhardtius hippoglossoides*) in relation to survey coverage and the physical environment. ICES J. Mar. Sci. 58: 1053-1062.

Based on annual bottom-trawl surveys in the Barents Sea and Svalbard area in 1983-2000, variations in distribution and abundance of age 1 Greenland halibut (*Reinhardtius hippoglossoides* Walbaum) are described. The surveys showed high contrasts in abundance during the period, with extremely low abundance in 1990-1995 associated with a northerly displacement of the distribution within the survey area. A reduced abundance was not reflected in VPA-based estimates of total abundance of 1-group halibut. We conclude that the survey covered a varying proportion of the total distribution area. Survey abundance, the range of distribution within the survey area, and the proportion covered by the surveys were all negatively correlated with temperature in the Atlantic Water of the Spitsbergen Current. Possible mechanisms linking survey results to the physical environment are discussed.

Albert, O.T., Nilssen, E.M., Stene, A., Gundersen, A.C., and Nedreaas, K.H. 2001. Maturity classes and spawning behaviour of Greenland halibut (*Reinhardtius hippoglossoides).* Fish. Res. 51 : 217-228.
[Special Issue: Deep-Water Fish and Fisheries: A selection of papers presented at the ICES Annual Science Conference in Lisbon, Portugal 16-18 September 1998]

The maturation and spawning of Greenland halibut (*Reinhardtius hippoglossoides* Walbaum) is described from six trawl surveys in the spawning area along the continental slope between North-Norway and Svalbard from October 1997 to May 1998. Different maturity classes were identified with frequency analyses of logarithmic classes of the Gonadosomatic Index. The main spawning period started in November, peaked in December and ended in late January. Mature females appeared at the spawning area in the early autumn and left during the first months of the year. Males were recorded after this with residual milt, indicating that some spawning may occur several months after the main spawning season. Observations from the fishery indicated spawning concentrations near the coast half a year after the main spawning period. Sex differences in spawning behaviour were discussed and related to the problem of representative sampling.

Albert, O.T., Harbitz, A., and Hines, A.S. 2003. Greenland halibut observed by video in front of survey trawl: behaviour, escapement, and spatial pattern. J. Sea Res. 50: 117-127.

Video recordings of Greenland halibut *(Reinhardtius hippoglossoides*) were made at eight trawl stations in Svalbard waters in August 2002. The recordings were made down to 600 m depth using artificial light. A method for calculating actual fish length from the video image was established and the recordings were analysed with respect to length-dependent behaviour, escapement and spatial pattern. All Greenland halibut observed were either lying on the bottom or swimming in a horizontal position close to the bottom, and there was no tendency to schooling. Individual fish reacted in an ordered way to the approaching trawl and were herded along the ends of the ground-gear. Escapement under the ground-gear was higher for smaller fish, while some larger individuals were apparently able to escape the trawl ahead of the observed region.

Albikovskaya, L.K., Gerasimova, O.V., and Kotlyarov, S.M. 1988. Feeding peculiarities of the main commercial fishes on the Flemish Cap and Northern Newfoundland Banks in spring-summer 1987. NAFO SCR documents 88/22: 12 p.

The qualitative and quantitative compositions of cod and redfish (*Sebastes mentella*) feeding on the Flemish Cap Bank (3M) as well as cod and Greenland halibut on the Northern Newfoundland Bank (3K) were studied by the materials collected in the cruise carried out by the RV "Persey-III" (MB-1202) in spring-summer 1987. The intensity of fish feeding in that period depended on prey distribution; on the whole, it was not high over the areas. A relationship between the fish size and specfies composition of their prey was well pronounced on the Flemish Cap Bank. Copepoda, Hyperiidae and also the redfish juveniles were the main food components of the commercial fishes. Species composition of food objects of cod and halibut with an increase of fish size is nearly unaffected on the Northern Newfoundland Bank. Shrimp and capelin are the main objects of their feeding.

Ali, I.B., Joiris, C.R., and Holsbeek, L. 1997. Polychlorinated biphenyls in Barents and Greenland Seas fish. Bull. Environ. Contam. Toxicol. 58: 885-892.

Haddock (*Melanogrammus aeglefinus*), long rough dab (*Hippoglossoides platessoides*), redfish (*Sebastes marinus and S. mentella*), Atlantic cod (*Gadus morhua*), Greenland halibut (*Reinhardtius hippoglossoides*), capelin (*Mallotus villosus*) and halibut (*Hippoglossus hippoglossus*) were collected from the Barents and Greenland seas during the summers of 1991 and 1992. Polychlorinated biphenyl (PCB) concentrations of the fish were determined using a sample of the medio-dorsal muscle by electron capture detection gas liquid chromatography. All species showed similar PCB concentrations when expressed on a lipid weight basis (200-300 ng/g lipid weight), with the exception of capelin (120 ng/g) and Atlantic cod (500 ng/g). It is suggested these exceptions may be due to differences in lipid composition, or migratory movements. Within each species a strong correlation between lipid content and PCB concentration was detected. It is concluded that the uptake of PCB is mainly directly from the water for both pelagic and demersal fish. Measurement of 4 of the 10 toxic coplanar PCB in these samples (118, 156, 138 and 170) indicated that they were not present at toxic levels, except possibly for 156 and 138 which contributed 62-90% of the total toxic equivalent values in haddock, long rough dab, halibut and Greenland halibut.

Allain, C. and Morice, J. 1971. French research report 1970. ICNAF Res. Doc. 71/46: 26 p.

Contents: A. Subarea 1 -- B. Subareas 3 and 4 (fishing from St. Pierre et Miquelon)

Allard, M.R. 1990. Kinguk survey : exploratory survey for marine groundfish and invertebrates in western Hudson Strait, northern Hudson Bay : project report. Unaaq Fisheries, Canada. 73 p.

Alpoim, R. and Vargas, J. 2004. Length-weight relationships from the Portuguese commercial catches in NAFO regulatory area, 1998-2003. NAFO SCR documents 04/40: 9 p.

The present assessment evaluates the status of the Division 3M American plaice stock. The catch at age matrix, EU survey abundance at age and the respective mean weights were updated. Both surveys and XSA estimated declines to very low values for abundance, biomass and SSB. Both F index (C/B ratio from the EU survey) and XSA fishing mortality were within 0.05 and 0.2 over the last years. There are no changes in the perception of the stock status from last assessment (2002). This stock continues to be in a very poor condition, with only weak year-classes recruiting to SSB for the next five years at least. Although the level of catches is low since 1996, this stock has been kept at a very low level with no sign of recovery.

Alpoim, R., Carneiro, M., Godinho, L., and Ávila de Melo, A.M. 1992. Portuguese research report for 1991. NAFO SCS documents 92/14: 68 p.

Alpoim, R., Ávila de Melo, A.M., Godinho, M.L., and Santos, E. 1994. Portuguese research report for 1993. NAFO SCS documents 94/13: 49 p.

Alpoim, R., Godinho, M.L., Santos, E., and Ávila de Melo, A.M. 1998. Portuguese research report for 1997. NAFO SCS documents 98/13: 38 p.

Alpoim, R., Santos, E., Vargas, J., and Ávila de Melo, A.M. 1999. Portuguese research report for 1998. NAFO SCS documents 99/16: 55 p.

Alpoim, R., Ávila de Melo, A.M., and Vargas, J. 2001. Observed catch/effort data and length composition of commercial species by month, depth strate and Division for the 1999-2000 Portuguese fisheries on NAFO regulatory area. NAFO SCR documents 01/67: 21 p.

Greenland halibut, redfish, American plaice, yellowtail flounder, skates and cod observed catch, effort and length data from the Portuguese fisheries on NAFO Regulatory Area in 1999 and 2000 were analysed on a tow by tow basis. The twelve months of two years (1999 and 2000), the four Divisions of Subarea 3 and four depth intervals were considered to allocate the observed tows into categories. Greenland halibut and redfish are the species with greater proportion in the overall sampled catch. In shallower waters less than 200 m in Div. 3N, American plaice and yellowtail flounder are the most abundant species in the catch during summer and fall, but the associated effort represents however less than 5% of the total observed effort in 1999 and 2000. Through winter and spring American plaice is also the main by-catch of the Greenland halibut fishery beyond 800 m in Div. 3N, with an average proportion of 19%. The average cod proportions in the catch are higher in Div. 3N and 3O at depths less than 500 m, but don't exceed 6%. Greenland halibut lengths greater than 60 cm are scared in the Portuguese catches regardless the year, month, Division and depth interval considered. For any of the species analysed no higher frequencies of lengths smaller than 30 cm can be allocated to a particular Division and/or depth interval.

Alpoim, R., Román, E., Greene, B., Burry, R., and Bowering, W.R. 2002. Results of the Greenland halibut (*Reinhardtius hippoglossoides*) otolith exchange between Spain, Canada and Portugal. NAFO SCR documents 14 p.

This Greenland halibut (*Reinhardtius hippoglossoides*) otolith exchange was carried out in order to examine for differences in age interpretations between Spain, Canada and Portugal. Statistical and graphical methods were used to evaluate differences in terms of bias and precision. In general, most differences in interpretations among age readers were within +/- 1-2 years although there were strong biases in several cases. The Spanish age reader had a tendency to assign lower ages to fish younger than 9 years old and higher ages to the older ones, relative to the Canadian age readers. The age reader from Portugal, like the Spanish age reader, assigned higher ages to the older fish (>8 years old) than Canada, but for the younger fish the agreement was very good. Burning the otoliths before reading seems to enhance the clarity in the last few annuli in older fish.

Alpoim, R., Vargas, J., Santos, E., and Ávila de Melo, A.M. 2002. Portuguese research report for 2001. NAFO SCS documents 02/6: 49 p.

Alton, M.S., Bakkala, R.G., Walters, G.E., and Munro, P.T. 1987. Greenland halibut (*Reinhardtius hippoglossoides*) of the eastern Bering Sea and the Aleutian Islands region : a review. NAFO SCR documents 87/79: 43 p.

Alton, M.S., Bakkala, R.G., Walters, G.E., and Munro, P.T. 1988. Greenland turbot *Reinhardtius hippoglossoides* of the eastern Bering Sea and Aleutian Islands region. NOAA Tech. Rep. NMFS Circ. 71: 34 p.

This report covers the history of harvest and management of this stock and describes the characteristics of the fisheries, such as nations and vessel types involved and the temporal and spatial patterns of harvest and catch-per-unit-effort. The report also traces changes that have occurred in the abundance and composition of the stock as inferred from both fisheries and research vessel survey data. A hypothesis is proposed for the eastern Bering Sea-Aleutian stock which describes the possible temporal and spatial pathways by which young fish recruit to the adult population.

Andersen, M. 1994. Denmark/Greenland national research report for 1993. NAFO SCS documents 94/15: 6 p.

Anon. 1982. Fisheries report of the German Democratic Republic on the subject of fulfilling the 1981 nation quota in Canada's fishing zone. Can. Transl. Fish. Aquat. Sci. 4886(1): 7 p. [Translated from German; Original appeared in VEB Fischfang Rostock Direktionsbereich Fang Abt. FVR, 1982]

Anon. 1983. Feeding habits of *Reinhardtius hippoglossoides* Walbaum. Can. Transl. Fish. Aquat. Sci. 5032: 8 p.
[Translated from Japanese: Teigyo Joho (17), 1958]

This article details the feeding habits of Greenland halibut (*Reinhardtius hippoglossoides*). In the food composition, fishes come first with a proportion of 40%, followed by small crustaceans, 27%, and squid (*Loliginidae, Ommastrephidae*) represent 2% and starfish (*Asteroidea*) 2%.

Anon. 1983. The ecology of *Reinhardtius hippoglossoides* Walbaum. Can. Transl. Fish. Aquat. Sci. 5036: 23 p.
[Translated from Japanese; Original appeared in Teigyo Joho (Benthonic Information) (21): 19-20; (23): 44-47; (24): 52-53]

This paper describes the distribution and body length composition of the Greenland halibut, *Reinhardtius hippoglossoides.*

Anon. 1997. Flatfish trawl nets rising deep halibut. Fish.News.Int. 36 (4): 44.

"We've delivered quite a few trawls for that fishery, which is in quite deep water. Vonin's Greenland halibut trawl is based on the Faeroese company's popular two-seam Bacalao trawls.

Anon. 2003. Survey report from the Joint Norwegian/Russian Ecosystem Survey in the Barents Sea August-October 2003. IMR/PINRO Joint Report series. 2. 51 p.

The joint ecosystem survey carried out during the period 27th of July to 2nd of October 2003 encompasses various surveys that previously have been carried out jointly or at national basis in previous years. Joint investigations include the IMR/PINRO 0-group survey and acoustic survey for pelagic fish (also known as the capelin survey). Oceanographic investigations have always formed a part of both these surveys, and in recent years, studies on plankton and sea mammals have been included. In addition, a

herring survey in the western parts of the Barents Sea and parts of the Norwegian Sea, a survey for bottom fishes in the western Barents Sea and a survey for young Greenland halibut north and east of Spitsbergen were also included in the ecosystem survey. The present report from the survey will cover many but not all the aspects of the survey. Main focus is on the hydrographical conditions of the Barents Sea, the results from the 0-group investigations and from the acoustic investigation on pelagic fish. Results from the investigations on plankton, bottom fishes and sea mammals will only be briefly mentioned, since the reporting of these investigations will have to await further working up of material in the laboratories. The report was made during a meeting between scientists participating in the survey, in Murmansk 3-9th October.

Aquaprojects Inc. and Canada. Dept. of Fisheries and Oceans. 1998. Protocol for conducting Greenland halibut (turbot) selectivity experiments aboard the M.V. Northern Osprey. Responsible fisheries (Canadian fisheries). 29 p.

Aquaprojects Inc., Canada. Dept.of Fisheries and Oceans, and Canada. Ministère des pêches et des oceans. 1999. Greenland halibut (turbot) experiments = Experiences du flétan (turbot) du Groenland. Responsible fisheries summary (Canadian fisheries). 8 p. [Text in English and French with French text on inverted pages]

Aquaprojects Inc. and Canada. Dept. of Fisheries and Oceans. 2001. Protocol for conducting Greenland halibut (turbot) selectivity experiments aboard the M.V. Arctic Endurance. Responsible fisheries (Canadian fisheries). 23 p.

Archambault, D., Chouinard, G.A., Hurlbut, T., Morin, B., Morin, R., Paul, S.D., Poirier, G.A., Porter, J.M., and Swain, D.P. 2001. Summary of information on the biology of exploited groundfish species and bluefin tuna in the southern Gulf of St. Lawrence = Résume de l'information sur la biologie du thon rouge et des espèces de poisson de fond exploiitées dans le sud du golfe du Saint-Laurent. Canadian Science Advisory Secretariat research document 2001/120: 53 p.

This document summarizes biological information on nine groundfish species and bluefin tuna in the southern Gulf of St. Lawrence. This is part of background information being provided in order to determine potential effects that may result from the development of oil and gas in an area of the southern Gulf. The species reviewed are Atlantic cod, white hake, American plaice, witch flounder, winter flounder, yellowtail flounder, Greenland halibut, redfish, Atlantic halibut and bluefin tuna. For each species, a review is made of literature on distribution, seasonal movements, stock composition, spawning, early life stages, and feeding.
[In English and French]

Arnason, R. 1995. Icelandic fisheries and fisheries management: adaptation to a limited resource base. *In* The North Atlantic fisheries: successes, failures & challenges. *Edited by* R.Arnason and L.Felt. University of Prince Edward Island. Institute of Island Studies, Charlotteotwn, P.E.I. pp. 237-266.

The Icelandic economy is to a large extent based on fisheries. Nevertheless, it has managed to provide Icelanders with consistently high living standards during the post-war period. This suggests that Icelanders may have overcome the rather well-known economic problems associated with ocean fisheries. This paper considers these issues. It outlines the structure and evolution of the fishing industry and its role in the national economy. It discusses the initial extensive development phase of the industry and the subsequent transition to an intensive development. Finally, the paper describes the adaptation of the fisheries management regime to the economic realities of limited fish stocks and the common property externalities of traditional harvesting arrangements. The paper suggests that an important explanation for the relative success of the Icelandic fishing industry is to be found in its adaptability both to the realities of a limited resource base and to changing technological and marketing conditions. This adaptability probably derives from the organizational structure of the fishing industry and the Icelandic socio-political environment.

Artemjeva, K.F., Chumakov, A.K., and Rudneva, G.B. 1987. Some indicators of the Greenland halibut local groups in the north Atlantic. NAFO SCR documents 87/90: 29 p.

Arthur, J.R. and Albert, E. 1992. The use of parasites for separating stocks of Greenland halibut (*Reinhardtius hippoglossoides*) in the Atlantic Ocean off Canada. CAFSAC Res. Doc. 92/93: 21 p.

A study was conducted to determine the usefulness of parasites as biological tags for stocks of Greenland halibut occurring off the Atlantic coast of Canada and in the Gulf of St. Lawrence. More than 40 species of parasites were identified from examination of a total of 231 large fish (<39 cm) collected from eight localities. Analyses using five taxa (*Corynosoma strumosum* juvenile, *Otodistomum* sp. *metacercaria, Contracaecinea* spp. larva, *Anisakis simplex* larva and *Pseudoterranova decipiens* larva) gave highly accurate results (almost 100% correct classification) for the separation of fish from the Gulf of St. Lawrence from those collected from adjacent areas of the Saguenay fjord and the Atlantic Ocean off Labrador. It is concluded that little, if any mixing of subadult or adult fish occurs among these areas.

Arthur, J.R. and Albert, E. 1993. Use of parasites for separating stocks of Greenland halibut (*Reinhardtius hippoglossoides)* in the Canadian Northwest Atlantic. Can. J. Fish. Aquat. Sci. 50 : 2175-2181.

The usefulness of parasites as biological tags for stocks of Greenland halibut (*Reinhardtius hippoglossoides*) occurring off the Atlantic coast of Canada and in the Gulf of St. Lawrence was investigated. Nonparametric discriminant function analyses of eight collections comprising a total of 231 large fish (>39 cm) using counts for selected parasite taxa (*Corynosoma strumosum* juvenile, *Otodistomum sp. metacercaria, Contracaecinea spp.* larva, *Anisakis simplex* larva, and *Pseudoterranova decipiens* larva) gave accurate results (almost 100% correct classification) for the separation of fish from the Gulf of St. Lawrence from those collected from adjacent areas of the Saguenay Fjord and the Atlantic Ocean off Labrador.

Arthur, J.R. and Albert, E. 1994. A survey of the parasites of Greenland halibut (*Reinhardtius hippoglossoides*) caught off Atlantic Canada, with notes on their zoogeography in this fish. Can. J. Zool. 72: 765-778.

A survey of the parasites of Greenland halibut (*Reinhardtius hippoglossoides*) caught in Canadian Atlantic waters extending from Cumberland Sound, Northwest Territories, to the Gulf of St. Lawrence and Saguenay Fjord was conducted during the period January 1990 to March 1991. From examination of 350 fish a total of 46 parasite taxa were identified (4 Myxosporea, 1 Monogenea, 19 Digenea, 6 Cestoda, 8 Nematoda, 5 Acanthocephala, 2 Crustacea, and 1 Hirudinoidea). Included among these are 15 taxa previously unreported from this fish (*Genolinea laticauda* Manter, 1925; *Gonocerca phycidis* Manter 1925; *Neophasis* sp.; *Podocotyle reflexa* (Creplin, 1825); *Prosorhynchus squamatus* Odhner, 1905; *Steringophorus* sp.; *Eubothrium parvum* Nybelin, 1922; *Proteocephalus* sp.; *Ascarophis arctica* Polyansky, 1952; *Ascarophis filiformis* Polyansky, 1952; *Spirurida gen.* sp. larva; *Corynosoma validum* Van Cleave, 1953; *Corynosoma wegeneri* Heinze, 1934; *Gnathia elongata (*Kroyer, 1849); and *Notostomum laeve* Levinsen, 1882). New Canadian records include only S*teringophorus* sp. and *N. laeve.* The parasite fauna of Greenland halibut is characterized by a large number of ubiquitous species, including many larval forms that show little host specificity, and a smaller number of species typical of pleuronectiform fishes, two of which (*Myxoproteus reinhardti* (Wierzbicka, 1986) and *Hatschekia reinhardtii* Wierzbicka, 1989) are known only from this fish. A complete listing of all parasite reported from Greenland halibut is included as an appendix.

Aschan, M. 1999. Bioeconomic analyses of by-catch of juvenile fish in the shrimp fisheries. Rapp. Fiskeriforsk. 24: 62 p.

Although the sorting grid was introduced in the shrimp fishery in 1991 in the Barents Sea, by-catch of juvenile fish in the shrimp catches, especially redfish, Greenland halibut, haddock and cod, are still a problem in certain areas depending on the time of year and the abundance of juvenile fish. The project aims at evaluating and further developing the bioeconomic model that is used by the Norwegian Directorate of Fisheries for calculating the allowable number of juvenile fish in the shrimp catch. It is of great importance to know how much of lost catches due to closure of areas may be compensated by increased catch per hour when the area is again opened. The project is using catch and effort data from the log books when evaluating how closing and opening of an area effect the catch per unit effort (CPUE). If only a minor amount of the shrimp lost due to closure is compensated by increased catches when the area is again opened, the model will accept a higher number of juveniles in the catch. The bioeconomic model will also be further developed by including updated biological knowledge achieved through multispesies research. Russian scientists have used biological models for estimating the allowed by-catch of juvenile fish. The criteria that should be full filled when the bioeconomic model is used are defined. The results of the bioeconomic model will be compared to those of the biological model.

Asche, F. and Gronning, S. 2001. Landings and effort in Norwegian fisheries. *In* Fisheries impacts on North Atlantic ecosystems: catch, effort and national/regional data sets. *Edited by* D.Zeller, R.Watson, and D.Pauly. The Fisheries Centre, University of British Columbia, Vancouver, B.C. pp. 88-91.

The present report documents official Norwegian fisheries catches (tonnage and value) from 1950-1999 for principal commercial species based on data from the Directorate of Fisheries, Norway. The species include: capelin (*Mallotus villosus*); Salmon and sea trout (smelts); halibut (*Hippoglossus hippoglossus*); Greenland halibut (*Reinhardtius hippoglossoides*); plaice (*Pleuronectes platessus*); witch (*Glyptocephalus cynoglossus*); tusk (*Brosme brosme*); haddock (*Melanogrammus aeglefinus*); spawning cod (*Gadus morhua*); Finmark young cod (*G. morhua*); other cod (*G. morhua)*; Norway pout (*Trisopterus esmarki)*; saithe (*Pollachius virens*); ling (*Molva molva*); blue ling (*Molva dypterygia*); winter herring (*Clupea harengus*); fat herring (C. harengus); redfish (*Sebastes* spp.); catfish (*Anarhichas* spp.); dogfish (e.g., *Squalus acanthias*); porbeagle (*Lamna nasus*); crab, lobster, deep water prawn, other fish and by-products. Some information on broad spatial breakdown of catches are also available. Furthermore, fishing effort by major gear types, listing number of sea-days, average vessel length and tonnage, and number of vessels are also summarized, although temporal coverage varies by gear type and only starts in the late 1960s.

Atkinson, D.B. 1993. Some observations on the biomass and abundance of fish captured during stratified random bottom trawl surveys in NAFO Divisions 2J3KL, Fall 1981-1991. NAFO SCR documents 93/29: 18 p.

Questions have been raised as to whether the observed declines in biomass of cod in NAFO Div. 2J3KL have been compensated for by increases in biomass of other species of marine life. This study examined the biomass of various fish species captured during annual fall research vessel surveys to see if increases coinciding with the decline in cod biomass could be detected. Declines in biomass were observed for all species examined. In most cases, the declines were greater than that for cod, and the proportion of cod biomass to total biomass showed some increase over time, particularly in Div. 2J. The declines in biomass were paralleled in most cases, by declines in abundance. It is still possible that compensatory increases in biomass have taken place in Div. 2J3KL in pelagic fish species, or non-fish species.

Atkinson, D.B. 2002. Proceedings of the workshop on Greenland halibut, Montreal, Quebec, 27 February-2 March 2001. Proceedings series (Canadian Science Advisory Secretariat); 2001/36: 102 p.

Based on DFO/Industry/province pre-NAFO Scientific Council discussions held in St. John's, Newfoundland during May 2000, it was agreed that a workshop focussed on Greenland halibut would be timely given the interest in this resource within Atlantic Canada including the north as well as the international aspects of the fishery. Funding for such a workshop was obtained and therefore, a Steering Committee chaired by D. Bollivar was struck, with the purpose of determining the Terms of Reference, venue, participants and agenda. The Workshop was held in Montreal, QC during 25-27 January 2001. There were 34 participants comprising representatives from DFO, industry, provinces, Nunavut and the Labrador Inuit Association. Discussions were wide-ranging and lively throughout. This document contains information as presented as well as summaries of the discussions on the various topics. It should be noted that formats vary and reflect the manner in which the presenters and rapporteurs provided material. A consensus summary including recommendations was developed. It is hoped that these will help guide Canada's activities with regard to sustainable exploitation of Greenland halibut into the future.

Atkinson, D.B. and Bowering, W.R. 1987. The distribution and abundance of Greenland halibut, deepwater redfish, golden redfish, roundnose grenadier and roughhead grenadier in Davis Strait. Can. Tech. Rep. Fish. Aquat. Sci. 1578: 29 p.

The distribution and abundance of Greenland halibut (Reinhardtius hippoglossoides Walbaum), deepwater redfish (Sebastes mentella Travin), golden redfish (Sebastes marinus L.), roundnose grenadier (Coryphaenoides rupestris Gunn.) and roughhead grenadier (Macrourus berglax Lacepede) in the Davis Strait area were examined in relation to geographic area, depth and temperature. Greenland halibut was the most abundant species and occurred throughout the area investigated. They were most abundant in depths of 900-1000 m, in bottom temperatures of 1.0-1.9 degree C. The mean size of these fish increased with depth.

Atkinson, D.B., Bowering, W.R., and Parsons, D.G. 1981. A review of the biology and fisheries for roundnose grenadier, Greenland halibut and northern shrimp in Davis Strait. Northwest Atl. Fish. Organ. Sci. Counc. Stud. 3: 7-27.

Three species of commercial importance inhabit the region between Baffin Island and West Greenland in NAFO Subareas 0 and 1: roundnose grenadier (*Coryphanoides rupesiris*), Greenland halibut (*Reinhardtius hippoglossoides*) and northern shrimp (*Pandalus borealis*). The roundnose grenadier is a deepwater species found in depths greater that 350 m where the temperature ranges from 3.0 degree to 4.4 degree C. Little is known about reproduction, feeding and migration of the species in the area. There has been a directed fishery since 9168, almost entirely by USSR vessels, and annual catches have fluctuated between 3,000 and 12,000 tons. Management of the fishery began with a toal allowable catch of 10,000 tons in 1975, and the TAC has remained at 8,000 tons annually since 1977. *R. hippoglossoides* is also a deepwater species inhabitng depths to 1,500 m at temperatures of 1-4 degree C. It is distributed widely along the west coast of Greenland, particularly in the deepwater fjords, and off Baffin Island south of the Davis Strait Rigde. Juvenile Greenland halibut (<30 cm long) are abundant on the continental shelf off Baffins Island. Spawning is in deepwater areas of Davis Strait and the larvae are

carried by currents to shallow-water nursery areas along West Greenland, particularly north of Disko Bay, and the banks off Baffin Island. The main food item in the diet is shrimp. Nominal catches in the region during 1969-78 have ranged from 2,000-25,000 tons taken mainly by USSR trawlers.

Atkinson, D.B., Bowering, W.R., Horsted, S.A., Minet, J.P., and Parsons, D.G. 1981. A review of the biology and fisheries of roundnose grenadier (*Macrourus rupestris)* Greenland halibut (*Reinhardtius hippoglossoides*) and shrimp (*Pandalus borealis)* in Davis Strait (NAFO subareas 0 and 1). NAFO SCR documents 81/6/22: 58 p.

During the mid 1970's when ICNAF began monitoring stocks more closely and imposing Total Allowable Catches (TACs), species found on both sides of the 59 deg W line between Baffin Island and Greenland were considered as one stock and managed accordingly. The extension of fisheries jurisdiction to 200 miles by Canada, United States of America, and member states of the European Economic Community (EEC) in 1977 necessitated the establishment of a new international fisheries convention and the Northwest Atlantic Fisheries Organization was founded to manage the stocks outside the 200 mile zones. The mandate of the Scientific Council of NAFO includes the provision of scientific advice for management of stocks partly or totally outside the 200 mile zones, and for stocks within these zones at the request of the coastal states concerned. In 1979, the boundary between what was ICNAF Subareas 0 and 1 was changed to represent the equidistant line between Canada and Greenland. This new boundary south of Div 1A falls much closer to the 58 deg W line. Control of the stocks overlapping NAFO Subareas 0 and 1 is to be shared by Canada and the EEC based on management advice provided through NAFO's Scientific Council. Among the species present on both sides of the new boundary only three are at present considered of commercial interest, viz. roundnose grenadier (*Macrourus rupestris*), Greenland halibut (*Reinhardtius hippoglossoides*), and shrimp (*Pandalus borealis*) and in early 1980, Canada and the EEC agreed on the principle that objective scientific criteria be made available to aid in allocating the TAC's for these joint stocks. Consequently a work group consisting of Canadian and EEC scientists was established to review the existing data. This paper is a review of the biology of fisheries of these species and represents the current state of knowledge concerning these three species in Subareas 0 and 1.

Atkinson, D.B., Bowering, W.R., and Brodie, W. 1994. Analysis of data collected by observers during the Greenland halibut otter trawl fisheries in Subarea 0 during 1988-1993. NAFO SCR documents.

With the decline in "traditional" groundfish resources off Canada's northeast coast during the late 1980s, interest increased in the deepwater resources further to the north. Beginning in the late 1980s' catches of Greenland halibut (*Reinhardtius hippoglossoides*) from NAFO Subarea 0 (primarily Div. 0B) began to increase. During 1988 and 1989, catches were taken primarily by long lines, but catches by otter trawlers gradually increased during the 1990s. Although some of this otter trawl fishery was prosecuted by Canadian vessels, much of the catch was taken by non-Canadian vessels fishing the Canadian quota under contract arrangements. There has been extensive observer coverage of this developing fishery. All trawlers carried observers, and detailed set by set information has been collected by them. In this paper, we present some of the information pertaining to catch rates and catch at age collected by these observers.

Auby, D.C.A. 2003. Tagging activities reported for the Northwest Atlantic in 2002 and early-2003. NAFO SCS documents 03/4: 9 p.

Auby, D.C.A. 2004. Tagging activities reported for the Northwest Atlantic in 2003 and early-2004. NAFO SCS documents 04/11: 8 p.

Auby, D.C.A. 2005. Tagging activities reported for the Northwest Atlantic in 2004 and early-2005. NAFO SCS documents 05/13: 6 p.

Ávila de Melo, A. and Alpoim, R. 1999. Recursos pesqueiros do Noroeste Atlantico: situacao actual com base nas avaliacoes de 1998 feitas pelo Conselho Cientifico da NAFO [Northwest Atlantic fish resources: their actual status based on the 1998 assessments of the NAFO Scientific Council]. Lisbon (Portugal), Instituto Nac. de Investigacao des Pescas. Relatorios cientificos e tecnicos. Instituto de Investigacao das Pescas e do Mar: 35: 24 p.
[In Portuguese, English summary]

The recent history of the Northwest Atlantic fisheries on the first half of this decade is dominated by the collapse of the three cod stocks that traditionally supported the Newfoundland Portuguese fisheries: the 3NO cod the 2J3KL cod (the northern cod) and the Flemish Cap cod. The collapse of the Grand Bank cod stocks results, in the authors perspective, of the accumulated action of three distinct factors: overfishing, extreme climate and oceanographic conditions during the late eighties and early nineties, and the continuous growth of the harp and hooded seals stocks and their concentration southwards, overlapping with the Grand Banks area. The collapse of the Flemish Cap cod is a direct consequence of the systematic overfishing of this stock at least during the 1985-1995 period. Simultaneously the American place stocks (from Div. 3 LNO and 3M) remain at their historical minimum which as regards the Grand Banks stock is coupled with seasonal migrations to depths well bellow the usual batimetric limit for this species distribution. The commercial fishing on the NAFO Regulatory Area outside the Canadian 200 mile limit has been gradually supported during the nineties by the Greenland halibut stock component of the Subarea 2 and Div. 3KLMNO. The appearance of this deep sea fishery was supported by a progressive Southeast movement of this stock component to deeper grounds (between 1000m and 1500m), which occurred during the second half of the last decade resulting on an increase of the concentration of this resource on international waters.

Ávila de Melo, A., Godinho, M.L.M., Alpoim, R.R., and Santos, E. 1993. Portuguese research report for 1992. NAFO SCS documents 93/15: 48 p.

Ávila de Melo, A., Alpoim, R., Godinho, M.L., and Santos, E. 1995. Portuguese research report for 1994. NAFO SCS documents 95/13 : 53 p.

Ávila de Melo, A.M. and Alpoim, R. 1996. Greenland halibut deepwater fishery in Divisions 3L and 3N: An analysis of catch rate trends from Portuguese trawlers, 1988-1995. NAFO SCR documents 96/33: 16 p.

From the observed catch rates of monitored Portuguese trawlers two cpue series are derived for Greenland halibut deepwater fishery in the NAFO regulatory area. Both series start in 1988, prior to the large scale fishery beginning in 1990, one corresponding to the effective mesh size in use till April 1995, assumed to be smaller than 130 mm due to the overall cod oriented strategy of the trawl fleet, and the other corresponding to the catch rates expected with a 130 mm mesh size in the cod-end. Within each division either series presents the same pattern over time, with the exception for 1994 in Division 3N, due to the starting of the 1990 year class recruitment. In Division 3L observed and estimated cpue's were still declining in 1995 together with a steady decrease of the proportion in weight of fish larger than 40 cm in the catch. On the contrary in Division 3N both cpue series don't present a obvious trend and the sudden drop in 1994 of the proportion of larger fish reflects basically the abundance and availability of small Greenland halibut at the time. In 1992 in Division 3N and in 1993 in Division 3L isolated increases in cpue's are observed, probably relaged with a simultaneous shift in the distribution of the 1988 and 1989 cohorts towards depths greater than 700 m in the NAFO regulatory area.

Ávila de Melo, A.M., Godinho, M.L., Alpoim, R., and Carneiro, M. 1990. Portuguese research report for 1989. NAFO SCS documents 90/12: 22 p.

Baird, J.W. and Bowering, W.R. 1986. Biomass estimates for cod and Greenland halibut beyond the Canadian 200 mile economic zone in NAFO Division 2J+3KL. NAFO SCR documents 86/51: 6 p.

Bakanev, S.V. 2001. Russian fishery for northern shrimp (*Pandalus borealis*) on Flemish Cap Bank, NAFO Division 3M and Grand Bank, Division 3L, in 2000 and January-September 2001. NAFO SCR documents 01/184: 9 p.

The paper gives a brief preliminary review of the Russian fishery for shrimp (*Pandalus borealis*) on Flemish Cap Bank and Grand Bank during January-December 2000 and January-September 2001. Maximum catches per effort were taken in June-July 2000 and January-May 2001. Length and sex compositions of catch by month are reported. Redfish (*Sebastes mentella*) were the most frequent in by-catch, as well as common wolffish. As well, spotted wolffish (*Anarhichas minor*), roughhead grenadier (*Macrousrus berglax*) and Greenland halibut (*Reinhardtius hippoglossoides*) were taken as by-catch.

Bakanev, S.V. 2002. Russian fishery for northern shrimp (*Pandalus borealis*) on Flemish Cap Bank, NAFO Division 3M and Grand Bank, Division 3L, in 2001 and January-September 2002. NAFO SCR documents 02/159: 9 p.

The paper gives a brief preliminary review of the Russian fishery for shrimp (*Pandalus borealis*) on Flemish Cap bank during January-December 2001 and January-September 2002. Maximum catches per effort were taken in January-May 2001 and February 2002. Length and sex compositions of catch by month in 2001 are reported. Redfish (*Sebastes mentella*) were the most frequent in by-catch, as well as common wolffish(*Anarhichas lupus*). Besides, spotted wolffish (*Anarhichas minor*), roughhead grenadier (*Macrourus berglax*) and Greenland halibut *(Reinhardtius hippoglossoides*) were taken as by-catch.

Bakken, E. and Lahn-Johannessen, J. 1975. Bunnfisk paa den Norske kontinentalskraaning [Demersal fish on the continental slope off Norway]. Fisken Havet 1975: 23-31.
[In Norwegian, English summary]

Investigations of distribution and abundance of demersal fish in 400- 1,000 m depth were carried out in 3 selected areas off Norway in July-Aug 1974. Based on catches in 48 hauls by bottom trawl and 3 longline settings the relationships between depth, fish quantity and spp composition were determined. In 800 m the catch in wt was reduced to {approx}10% and in 1,000 m to 1% of that taken on the edge of the shelf (400-500m). The number of fish spp caught was reduced from {approx}10 to 3 over the same depth range, as boreal spp were replaced by a few Arctic spp. Trawl catches were small, {approx} 70 kg per h in 600 m, while longline in this depth gave 150 kg/1,000 hooks; mostly *Macrourus berglax*, *Raja hyperborea* and *Reinhardtius hippoglossoides*. The abundance and vertical distribution of the fish on the continental slope are closely related to the hydrography of the Norwegian Sea. Atlantic water with a temp of 5-7{degree}C covers the edge of the shelf down to {approx}500 m while deep water of Arctic origin with a typical temp of "C0.9 {degree}C is found along the slope in depths below 600-700 m. An intermediate, variable layer occurs between. Prospects of commercial utilization of the fish resources on the slope are discussed.

Barrett, D. 1992. Deep water fishery for turbot and roughhead grenadier by vessels <65', 189-90-91. Canada/Newfoundland Inshore Fisheries Development Agreement. Underutilized

Species Program, St. John's, Newfoundland. 32 p.

The purpose of this report is to summarize what has happened in this experimental or exploratory deep water turbot fishery since 1989 and provide a current assessment of the commercial viability of the fishery with a view to what further developmental work should be done to maximize the benefits of this fishery to both fishermen and processors.

Barrett, D. 1992. Deep water turbot explorations by offshore otter trawl vessels : summary report for 1990 and 1991. Atlantic Fisheries Adjustment Program (Canada). Underutilized Species Component, St. John's, Newfoundland. 25 p.

This report attempts to describe the fishing areas, fishing gear, catches and fishing effort for these projects and provides an indication of the potential for this resource for the fishing industry.

Barry, D. 1998. The Canada-European Union turbot war : internal politics and transatlantic bargaining. International Journal 53(2): 253-284.

This article argues that the European Union attempted to increase its turbot quota in response to pressures from the Spanish government and industry. Canada sought to impose an enforceable limit on European Union vessels to maintain a viable fishery in the face of long-standing domestic frustration over their fishing practices. The dispute was resolved by an agreement that raised the European Union's turbot allocation and established a comprehensive control and enforcement regime to govern fishing outside Canada's offshore zone. The agreement addressed both the Union's access goal and Canada's aim of effective surveillance and policing. It also gave the European Union an additional measure of assurance of member-state compliance with European Union commitments.

Bax, N.J. and Laevastu, T. 1987. Recruitment of Bering Sea Pacific cod and walleye pollock to the fisheries of different nations and processors from 1983 to 1986, and implications for management. ICES CM 1987/G:8: 24 p.

This paper presents a comparison of the activities of the different fisheries operating in the Bering Sea and their area and annual variability.

Bech, G. 1993. Survey biomass and abundance of Greenland halibut (*Reinhardtius hippoglossoides*) and redfish (*Sebastes* spp.) in Greenland trawl survey 1992 (NAFO Subarea 1). NAFO SCR documents 93/52: 8 p.

A stratified-random survey was performed with a shrimp trawl off West Greenland during July to September 1992. In August 1992 an inshore area, Disko Bay, was also surveyed. This paper presents estimates of biomass, abundance indices and length frequency distributions of Greenland Halibut and Redfish based on data collected during the survey.

Bech, G. 1994. Biomass and abundance of Greenland halibut (*Reinhardtius hippoglossoides*) and redfish (*Sebastes* spp.) from a bottom trawl survey in NAFO Subarea 1 in 1993. NAFO SCR documents 94/9: 12 p.

A stratified-random survey was performed with a shrimp trawl off West Greenland and in the Disko Bay during July to September 1993. This paper presents estimates of biomass, abundance indices and length distributions of Greenland halibut (*Reinhardtius hippoglossoides*) and redfish (*Sebastes*) based on data collected during the survey. Catch-per-unit effort indices are calculated for the years 1991 to 1993.

Bech, G. 1995. An assessment of the inshore Greenland halibut stock component in NAFO Division 1A. NAFO SCR documents 95/67: 9 p.

The Greenland halibut (*Reinhardtius hippoglossoides*) stock component in Division 1A is considered as a separate part of the Davis Strait stock (Boje et al. 1994). The stock does not contribute to the spawning stock in Davis Strait (Boje, 1994) and spawning is only sporadical in the inshore area where all the fishery takes place (Joergensen & Boje, 1994). Hence the inshore stock is not a self-sustainable stock, but dependent on recruitment from the nursery area south of Disko Island. There is practically no offshore fishing for Greenland halibut in Division 1A. In 1994, 18 tons were taken by a Greenland longliner. The main inshore fishing grounds for Greenland halibut is located in Division 1A, where total landings amounted to 14,049 tons in 1994, comprising 99% of the total inshore landings in Greenland. The inshore landings in Division 1A were around 7,000 tons in the late 1980's, but have been steadily increasing to 8,000 tons in 1990 and 14,000 tons in 1994. In recent years the inshore landings are rather evenly distributed throughout the year.

Bech, G. 1995. Recruitment of Greenland halibut at West Greenland. NAFO SCR documents 95/19: 12 p.

Since 1988 the Greenland trawl survey has been conducted off West Greenland with sommercial shrimp trawlers. The main purpose of the survey is to evaluate the biomass of Northern shrimp (*Pandalus borealis*) hence the gear used is a shrimp trawl. However the bycatches of fish has been used to get biomass and abundance indices for commercial important species. During the last years the sampling of fish has improved and the survey is considered as a combined groundfish/shrimp survey. Mose effort is concentrated at the areas where the commercial shrimp trawling is placed, especially on the northern slopes of the grand bank Store Hellefiskebanke and in the inshore area Disko Bay, places also known to be nursery areas for Greenland halibut. This paper presents a recruitment indes for the Greenland halibut based on the surveys in 1988 to 1994.

Bech, G., Boje, J., and Pedersen, C.B. 1996. An assessment of the inshore Greenland halibut stock component in NAFO Division 1A. NAFO SCR documents 96/68: 22 p.

The Greenland halibut (*Reinhardtius hippoglossoides*) stock component in Division 1A is considered as a separate part of the Davis Strait stock. The component probably does not contribute to the spawning stock in Davis Strait and only sporadic spawning is observed in the inshore area. Hence the inshore component is not assumed to be a self-sustainable stock, but dependent on recruitment from the nursery area south of Disko Island. The main inshore fishing grounds for Greenland halibut are in Divisions 1A, where total landings amounted to 17,903 tons in 1995, comprising 99.5% of the total inshore landings in Greenland. The inshore landings in Division 1A were around 7,000 tons in the late 1980s but increased steadily to 14,000 tons in 1994 and reached record high 18,000 tons in 1995. In recent years the inshore landings are rather evenly distributed throughout the year.

Belleau, L. and Simard, R.E. 1987. Effects of carbon dioxide and nitrogen on fish fillets. Sci.Aliments 7: 433-446.
[In French]

Fillets of Greenland halibut (*Reinhardtius hippoglossoides*) were stored in an atmosphere with various proportions of CO2 and N2. Although several biochemical parameters were observed to change in the fillets, an acceptable level of bacterial contamination (1 .times. 106) was maintained. The extent of the decrease in pH up to the third day was related to the percentage of CO2 in the atmosphere; this parameter was then stable for subsequent days. The firmness of fillets packed in the presence of different concentrations of CO2 changed. Significant differences (P < 0.01) were noted between the firmness of fillets in a 100% N2 atmosphere and those in atmospheres containing at least 25% CO2. A relationship was established between firmness and pH, the volume of exudate, and the level of CO2 in the atmosphere, the coefficient of correlation was 0.76. The results made it possible to construct equations relating the weight of the fillets and the loss by exudation. At two and six days, the coefficients of correlation were 0.8 and 0.70 respectively. This study found that a mixture of 25% CO2 and 75% N2 preserved packaged fillets in a state most resembling initial conditions with respect to pH (7.14), firmness (99.3 KPa), and an absence of exudation.

Berenboim, B.I. and Bakanev, S.V. 2000. Russian fishery of shrimp (*Pandalus borealis*) on Flemish Cap Bank (NAFO Division 3M) in 1999 and in March-September 2000. NAFO SCR documents 00/80: 5 p.

This paper gives a brief preliminary review of the Russian fishery for shrimp (*Pandalus borealis*) on Flemish Cap Bank from March-November 1999 and March-September 2000. Maximum catch per effort were taken in June-August 1999 and in March-July 2000. Length and sex compositions of catch by month are reported. Redfish (*Sebastes* spp.) were the most frequent in by catch (up to 430 indiv./ t of shrimp in June 2000), as well as common wolffish (*Anarhichus* spp.) (up to 188 indiv./1 t in May 2000). Spotted wolffish (*Anarhichus minor)*, roughhead grenadier (*Macrourus berglax*) and Greenland halibut (*Reinhardtius hipploglossoides)* were taken as by catch.

Berg, V., Ugland, K.I., Hareide, N.-R., Aspholm, P.E., Polder, A., and Skaare, J.U. 1997. Organochlorine contamination in deep-sea fish from the Davis Strait. Mar. Environ. Res. 44: 135-148.

Eight species of deep-sea fish caught at various depths off the west coast of Greenland exhibited low to moderate organochlorine (OC) contamination. Polychlorinated biphenyls (PCBs) and dichlorodiphenyltrichloroethane metabolites (DDTs) were the dominating organochlorines. Hepatic levels of sum-PCB (19 individual PCB congeners) ranged from 110 ng g-1 lipid weight in jelly wolf-fish (*Anarhichas denticulatus)* to 1156 ng g-1 in blue hake (*Antimora rostrata*). Sum-DDT (p,p'-DDE, o,p'-DDD, p,p'-DDD, multiplied by a factor (1.11), and p,p'-DDT) ranged from 70 ng g-1 in jelly wolf-fish to 1446 ng/g in blue hake. Sum-chlordanes (oxychlordane and trans-nonachlor) ranged from 28 ng g-1 in jelly wolf-fish to 309 ng g-1 in roughhead grenadier (*Macrourus berglax*). HCB (hexachlorobenzene) ranged from 3.6 ng g-1 in smalleyed rabbit-fish *(Hydrolagus affinis*) to 73 ng g-1 in tusk (*Brosme brosme*). Sum-HCH (hexachlorocyclohexanes [alpha]-HCH, [beta]-HCH and [gamma]-HCH) was of minor importance with levels ranging from 9.3 ng g-1 in Greenland halibut (*Reinhardtius hippoglossoides*) to 22 ng g-1 in tusk. The levels are lower than most of the corresponding published data from deep-sea fish and probably reflect a moderately contaminated area. No simple relationship was found between organochlorine contamination and depth range of the investigated species.

Bergstad, O.A., Bjelland, O., and Gordon, J.D.M. 1998. Fish communities on the slope of the eastern Norwegian Sea. ICES CM 1998/O:30: 29 p.

Bottom trawl data from the depth interval 300 - 2050 m on the slope off Norway were analysed to study distribution of fish biomass and the associated species assemblages. It is hypothesised that the pronounced hydrographic front between the warm Atlantic watermass and the cold Norwegian Sea deep-water, combined with a declining food supply with depth and distance from the shelf, structure the assemblages on the continental slope of the eastern Norwegian Sea. From a high level at the shelf edge and upper slope, the fish biomass declined abruptly at about 720 m when crossing the 0 degree C-isotherm associated with the hydrographic front. Beneath the frontal zone, the fish biomass was only 11 % of that above it and decreased further with increasing depth. In upper slope waters, the fish biomass increased with increasing latitude. Arctic species such as *Lycodes frigidus* and *Paraliparis bathybius* were dominant in the deep cold slope waters. The high fish biomass associated with the steep temperature gradient at 600-720 m was mainly attributable to a few large and/or abundant boreo-arctic species, i.e. Greenland halibut *Reinhardtius hippoglossoides*, redfishes *Sebastes mentella* and *S. marinus*, roughhead grenadier *Macrourus berglax*, and *Raja hyperborea*. In the shallower and warmer upper slope waters a species assemblage occurred which resembled that associated with adjacent deep shelf areas strongly influenced by the Atlantic watermass.

Bergstad, O.A., Bjelland, O., and Gordon, J.D.M. 1999. Fish communities on the slope of the eastern Norwegian Sea. Sarsia 84: 67-78.

Bottom trawl data from the depth interval 300-2050 m on the slope off Norway were analysed to study distribution of fish biomass and the associated species assemblages. It is hypothesised that the pronounced hydrographic front between the warm Atlantic watermass and the cold Norwegian Sea deep-water, combined with a declining food supply with depth and distance from the shelf, structure the assemblages on the continental slope of the eastern Norwegian Sea. From a high level at the shelf edge and upper slope, the fish biomass declined abruptly at about 720 m when crossing the 0 degree C-isotherm associated with the hydrographic front. Beneath the frontal zone, the fish biomass was only 11% of that above it and decreased further with increasing depth. In upper slope waters, the fish biomass increased with increasing latitude. Arctic species such as *Lycodes frigidus* and *Paraliparis bathybius* were dominant in the deep cold slope waters. The high fish biomass associated with the steep temperature gradient at 600-720 m was mainly attributable to a few large and/or abundant boreo-arctic species, i.e. Greenland halibut *Reinhardtius hippoglossoides*, redfishes *Sebastes mentella* and *S. marinus*, roughhead grenadier *Macrourus berglax*, and *Raja hyperborea*. In the shallower and warmer upper slope waters a species assemblage occurred which resembled that associated with adjacent deep shelf areas strongly influenced by the Atlantic watermass.

Bjelland, O. and Bergstad, O.A. 1998. Trophic ecology of deepwater fishes associated with the continental slope of the eastern Norwegian Sea. ICES CM 1998/O:51: 26 p.

In June 1995 and 1996 demersal fishes on the continental slope of the eastern Norwegian Sea were sampled to study distribution patterns and community structure. The diets of the more abundant slope species were characterised and linkages within the upper slope food-web identified. Few cases of predator-prey relationships between the typical slope fishes were found. Most of the smaller fishes fed on epibenthis crustaceans such an amphipods and mysids, while pelagic crustaceans and fish dominated the diets of larger fishes. Herring and blue whiting were important prey items of Greenland halibut, and were also eaten by *Lycodes frigidus*, *Raja hyuperborea* and roughhead grenadier. At least for the latter three species this probably reflected scavenging.

Bjelland, O., Bergstad, O.A., Skjaeraasen, J.E., and Meland, K. 2000. Trophic ecology of deep-water fishes associated with the continental slope of the eastern Norwegian Sea. Sarsia 85: 101-117.

In June 1995 and 1996 demersal fishes on the continental slope of the eastern Norwegian Sea were sampled to study distribution patterns and community structure. The diets of the more abundant slope species were characterised and linkages within the upper slope food web identified. Most of the smaller fishes fed on hyperbenthic crustaceans such as amphipods and mysids, while pelagic crustaceans and fish dominated the diets of larger fishes. Herring (*Clupea harengus*) and blue whiting (*Micromesistius poutassou*) were important prey items of Greenland halibut (*Reinhardtius hippoglossoides*), and were also eaten by *Lycodes frigidus*, *Raja hyperborea*, and roughhead grenadier (*Macrourus* *berglax).* At least for the latter three species this probably reflected scavenging. Few cases of predator-prey relationships between the typical slope fishes were found.

Bjordal, Å. and Boltnev, A. 2004. An ecosystem approach to fisheries management in the Barents Sea. *In* Management strategies for commercial marine species in northern ecosystems: proceedings of the 10th Norwegian-Russian Symposium Bergen. *Edited by* Bjordal, Å., Gjøsaeter, H., and Mehl, S. IMR/PINRO Joint Report Series: 1: p. 152-155.

The Barents Sea, named after the Dutch explorer Willem Barents (1549-97) covers an area of about 1,4 million km super(2), with water depths mainly between 200- and 500 m. Being a relatively shallow ocean and due to the inflow of warm and nutritious Atlantic water, the Barents Sea ecosystem has a very high productivity--as compared with other arctic ocean areas. The first large scale exploitation of living marine resources of the Barents sea was the catch of marine mammals like whales, seals and walrus from the 17th century as well as cod that mainly was fished in coastal waters during the spawning migration. In the early 20th century, most of the large whale species were overexploited and there was also a strong exploitation pressure on the seal stocks. After World war II, there was a rapid development of offshore fishing operations in the Barents sea--not only for cod, but also for several other target species like haddock, redfish, Greenland halibut, polar cod, capelin and shrimp. Over the same period the exploitation of marine mammals was gradually reduced to zero or very low levels. At present the harvest of marine mammals is limited to the traditional Norwegian whaling for Minke whale in accordance with recommendations from the Scientific committee of the International whaling commission and Norwegian and Russian hunt for harp seals in accordance with recommendations from the International Council for Exploration of the Sea (ICES). ICES also provides quota recommendations for sustainable development of the Barents Sea fisheries on the different fish stocks mentioned above.

Blagoderov, A.I. and Kolesova, N.G. 1985. Qualitative and quantitative changes in the composition of bottom fishes on the shelf of the west coast of Kamchatka Russian-SFSR USSR. Vopr. Ikhtiol. 25: 590-596.
[In Russian]

Data were presented on the percentage that each of the following flounder spp. constituted in 1932-1956: *Limanda aspera, L. punctatissima, L. sakhalinensis, Platichthys stellatus, Pleuronectes quadrituberculatus, Glyptocephalus stelleri, Lepidopsetta bilineata, Hippoglossoides elassodon* and halibuts of the genera *Hippoglossus, Atherestes* and *Reinhardtius*, as well as on *Eleginus gracilis*, Pleuronectid flounder and other groups of bottom fishes in 1961-1965 and 1961-1978. Significant changes were observed in species composition during these periods. However, flounders retained their dominant position. Natural environmental factors and the fishing industry cause changes in the ratio of individual species.

Bohn, A. 1975. Arsenic in marine organisms from West Greenland. Mar. Pollut. Bull. 6: 87-89.

Natural background levels of trace metals in marine organisms from a West Greenland inlet were studied during the summer of 1972 and 1973. Dry weight arsenic levels ranged from 11.1 to 307 ppm in fish fillets and from 7.6 to 512 ppm in fish livers. Prawns had As levels ranging up to 80.2 ppm, contrasting with 6.0 ppm in planktonic copepods. The results suggest that in certain marine organisms organo-arsenics predominate and are less toxic than inorganic As compounds. Spp analysed included prawns, *Pandalus borealis* and 5 spp of fish including G*adus ogac, Anarhichas minor* and *Reinhardtius hippoglossoides*.

Boje, J. 1990. On recaptures of Greenland halibut in Icelandic waters from tagging experiments in West Greenland fjords. NAFO SCR documents 90/37: 2 p.

This paper describes the long-distance migrations from the recent tagging experiments and relates these to the fishery for Greenland halibut in Icelandic waters.

Boje, J. 1991. A comparison of selectivity in longlines and gillnets in the fishery for Greenland halibut in west Greenland. NAFO SCR documents 91/39: 7 p.

Traditionally, the fishery for Greenland halibut in the fjords of West Greenland, were carried out by means of longlines, as a summer fishery from small boats and as a winter fishery from the sea-ice by means of dog-sledges. The present longline fishery has not changed much in terms of new technology.

Boje, J. 1991. An assessment of the Greenland halibut stock component in NAFO subareas 0+1. NAFO SCR documents 91/38: 12 p.

Boje, J. 1992. An assessment of the Greenland halibut stock component in NAFO 0+1. NAFO SCR documents 92/51: 4 p.

Boje, J. 1993. Migrations of Greenland halibut in the Northwest Atlantic from tagging experiments in West Greenland 1986-1989. ICES CM 1993/G:65: 14 p.

Migrations of Greenland halibut in the Northwest Atlantic were evaluated by tagging experiments in West Greenland fjords during 1986-1989. Of 2690 Greenland halibut tagged using longlines, 10.2% had been recovered by the first half of 1993. Of 959 Greenland halibut tagged in southern fjords at West Greenland long distance migrants were recorded, while of the remaining 1731 Greenland halibut tagged in northern fjords at West Greenland all recaptures were recorded at the tagging site or more rarely within a distance of 50 nautical miles from the tagging site. Of the 7 long distance migrants, 6 were recaptured in the Denmark Strait west of Iceland and one was recaptured off Newfoundland on the slope of the Grand Bank. This pattern of recaptures indicate a connection between Greenland halibut in the southern fjords of West Greenland and the stock component west of Iceland. Contrary to this, adult Greenland halibut from the northern fjords at West Greenland seem very stationary although they have reached maturity.

Boje, J. 1994. Migrations of Greenland halibut in the Northwest Atlantic based on tagging experiments in Greenland waters, 1986-1992. NAFO SCR documents 94/18: 13 p.

Migrations of Greenland halibut (*Reinhardtius hippoglossoides*) in the Northwest Atlantic are evaluated by tagging experiments off Greenland during 1986-1992. Of 3981 Greenland halibut tagged using longlines, 6.7% have been recovered until the first quarter of 1994. 6 long-distance migrants from Godthaab Fjord (Div. 1A) and 3 migrants from a fjord at Ammassalik in East Greenland to Icelandic waters (Div. XIVb and Va), indicate a connection between Greenland halibut in the southern fjords of West and East Greenland and the stock component west of Iceland. Greenland halibut tagged in northern fjords at West Greenland were all recaptures at the tagging site or within a distance of 50 nautical miles from the tagging site, thus adult Greenland halibut from the northern fjords at West Greenland seem very stationary.

Boje, J. 1999. Intermingling and seasonal migrations of Greenland halibut stock components in the Northwest Atlantic based on tagging studies. NAFO SCR documents 99/25: 13 p.

A study was carried out to clarify the stock discreteness and migration routes of Greenland halibut in the northwest Atlantic and to describe the seasonal movements of several fjord populations. From a total of 7244 Greenland halibut tagged in Greenland waters between 1986 and 1998, 517 recaptures were recorded in the Northwest Atlantic area. Among halibut released in the Davis Strait, Baffin Bay, and the fjords of southwestern and eastern Greenland, a substantial portion migrated distrances up to 2500 kilometres, primarily to the Denmark Strait between Greenland and Iceland, but also from the fjords of western Greenland to the Newfoundland coast. These recaptures were mainly larger specimen, indicating a prespawning migration. Estimating the age of recaptures based on length provided evidence that some Greenland halibut inhabiting the Davis Strait and the fjords of southwestern and eastern Greenland originate in the spawning grounds west of Iceland. The prevalent high mobility of Greenland halibut from Baffin Bay and the Davis Strait in these areas suggests that extensive feeding and prespawning migrations occur for these offshore halibut populations. Greenland halibut in the fjords of northwestern Greenland appear to be resident and do not intermingle with other offshore or more southerly inshore populations. Some intermingling of populations was observed in the northwestern fjords and a seasonality in the recovery pattern indicates an aggregation of Greenland halibut in the inner part of fjords in the second half of the year, while the population was more dispersed during the first half of the year. The data suggests that such seasonal movement may be related to feeding behaviour.

Boje, J. 2002. Intermingling and seasonal migrations of Greenland halibut (*Reinhardtius hippoglossoides*) populations determined from tagging studies. Fish.Bull. (Wash.D.C.) 100: 414-422.

A total of 7244 Greenland halibut (*Reinhardtius hippoglossoides*, Walbaum) were tagged in Greenland waters between 1986 and 1998 to increase information on stock delineations, to clarify migration routes, and to describe the seasonal movements of fjord populations. At present 517 recaptured Greenland halibut have been recorded. For Greenland halibut released in Davis Strait, Baffin Bay, and the fjords of southwestern and eastern Greenland, a substantial portion of recovered fish demonstrated migratory behavior, up to 2500 km, primarily to Denmark Strait between Greenland and Iceland. The recaptured fish provided evidence of intermingling between the population in Denmark Strait and the populations in Davis Strait and the southwest Greenland fjords. These observations support those of other studies that indicate that Greenland halibut inhabiting Davis Strait and the fjords of southwestern and eastern Greenland originate in the spawning grounds west of Iceland. The high mobility of offshore Greenland halibut within Baffin Bay and Davis Strait suggests that Greenland halibut migrate extensively between feeding and spawning areas. Greenland halibut in the fjords of northwestern Greenland appear to be resident in behavior and do not intermingle with offshore or more southerly inshore populations. A seasonal pattern in the recovery of these fish indicates that Greenland halibut aggregate in the inner part of fjords during the second half of the year (when inshore waters are not covered with ice).

Boje, J. and Hareide, N.-R. 1993. Trial deepwater longline fishery in the Davis Strait, May-June 1992. NAFO SCR documents 93/53: 6 p.

A longline trial fishery for deepwater fish resources in NAFO Divisions 1D and 1E in the Davis Strait was carried out in May-June 1992 by a Norwegian longliner "Skarheim." The trial fishery is part of a cooperation between More and Romsdal Research Foundation and Greenland Fisheries Research Institute, and was supported by the Norwegian Government. The aim of the fishery was to survey the unexploited fish resources at the deeper waters, i.e. at depths to 2000 meters, mainly focusing on Greenland halibut (*Reinhardtius hippoglossoides* Walbaum) and roughhead grenadier (*Macrourus berglax* Lacepe'de 1801). The fishery was a continuation of trial longline fisheries in the Davis Strait conducted since 1989 (Nielsen 1990, Jorgensen & Boje 1992). At lower depths at the continental slopes in Division 1E, some effort was spent on a fishery for Cusk (*Brosme brosme*).

Boje, J. and Hjörleifsson, E. 2000. Nursery grounds for the West Nordic Greenland halibut stock - where are they? ICES CM 2000/N:03: 12 p.

Greenland halibut (*Reinhardtius hippoglossoides*) in the Northwest Atlantic is composed of two management units reflecting the stock entities, namely the Canada-Greenland stock complex and the East Greenland/Iceland/Faroe Island stock (West Nordic stock). Major juvenile concentrations (nursery grounds) of the Canada-Greenland stock are located at the slope of Store Hellefisk Bank but similar concentrations of the West Nordic stock have not been located. Nursery grounds are traditionally believed to be located off East Greenland, since 0-group surveys show that eggs and larvae drift from spawning grounds west of Iceland towards East Greenland. An analysis of the combined data bases of Greenland halibut by-catch in research shrimp surveys from 1988 to 1999 in Icelandic and Greenland waters (4190 hauls, 637 thousand length records) was done in order to determine possible locations of nursery grounds for the West Nordic stock. At West Greenland, most catches are comprised of fish below 40 cm (juveniles) while at East Greenland and Iceland lengths ranges between 30 cm and 60 cm (immature adults). Length modes corresponding to age I-3 years old, which dominates in West Greenland waters are virtually absent in East Greenland and Icelandic waters. The catch rates of juveniles in West Greenland are more than one order of magnitude higher than in East Greenland and Icelandic water. The analysis of Greenland halibut by-catches in shrimp surveys suggest that main nursery grounds for the West Nordic stock must be located outside East Greenland of Icelandic waters.

Boje, J. and Hovgard, H. 1995. Selectivity in gillnets in the Greenland halibut fishery at Greenland. ICES CM 1995/B:17: 5 p.

The catches of Greenland halibut in the fjords of West Greenland has increased substantially due to the introduction of gill-nets and this has caused a fear for an over exploitation of the resource. In order to examine the potentials for a mesh size regulations of the fishery the mesh selection was estimated for a 90 mm and a 110 mm mesh using the method of Holt (1963). The experiment showed a clear mesh-size selection. The selectivity factor was estimated at 6.85 which is close to values seen for other flatfish species.

Boje, J. and Jørgensen, O. 1990. On the relevance of a combined assessment of Greenland halibut in NAFO Subareas 0, 1, 2 and Division 3KL. NAFO SCR documents 90/35: 7 p.

At present, stock assessment of Greenland halibut is made separately for the Gulf of St. Lawrence, Labrador-Newfoundland and the Davis Strait. Based on an examination of the biological information on Greenland halibut in the Northwest Atlantic the relevance of combining the assessment for Subarea 0+1 and Subarea 2 and Div. 3KL is discussed. It is concluded that the assessment for the two areas should be combined, except for the populations in West Greenland fiords.

Boje, J. and Jørgensen, O.A. 1991. Growth of Greenland halibut in the Northwest Atlantic. ICES CM 1991/G:40: 12 p.

More than 4000 otoliths were sampled from Greenland halibut (*Reinhardtius hippoglossoides*) in the years 1986-1990 from nine areas around Greenland, inshore as well as offshore, in NAFO Subarea 1 and in ICES Subarea XIVb, in order to examine differences in growth within the area. Analyses of a differences in proportions of females in the age-length keys were interpreted as growth of females was faster than that of males at lengths above approximately 60 cm. Mean age-at-length relations for the areas studied were linear. Covariance analyses, testing for differences in mean age-at-length between the areas sampled, reveals significance for area effects, however when visualizing the linear regressions in terms of plots, growth seemed very similar between the areas and hence it is concluded that the growth parameter is not a useful tool for stock discrimination studies of Greenland halibut in the Northwest Atlantic.

Boje, J. and Lyberth, B. 2004. An assessment of the Greenland halibut stock component in NAFO Division 1A inshore. NAFO SCR documents 04/51: 22 p.

This paper presents the assessment of Greenland halibut in the inshore part of NAFO Div. 1A. The area covers the fjords in the three distinctive geographical areas, Disko Bay, Uummannaq and Upernavik. Information from the commercial fishery (only landings, no effort information) and research survey (longline survey in two of the three areas in rotation, approx. 30 fixed stations in each area and a newly initiated gillnet survey) were available for the assessment. The state of the stocks were as follows. Disko Bay: In the recent two decades annual landings increased from about 2 000 tons in 1987 to 10 500 tons in 1998 and 99. Since then landings increased again in 2002 to a record high of nearly 12 000 tons. Catches by season in 2003 showed that unusual high catches were taken in the 1st quarter of the year, probably affected by favourable ice and weather conditions. Recruitment indices from Disko Bay and offshore areas suggest high 1995 and onward year-classes, which the fishery might benefit in these years. In the winter fishery mean lengths has decreased for the past three years while the overall trend for the summer fishery is a slight increase over all years. A newly established gillnet survey (since 2001) shows stable catch rates from 2002 to 2003. The long line survey that started in 1993 has ceased in 2001. Uummannaq: Catches have been increasing from less than 2 000 tons before 1987 to a record high of 8 425 tons in 1999, but have since declined to 5 039 tons in 2003. Development in mean length in the summer fishery has showed an overall negative trend until 1999. Since then mean length in catches has increased slightly. In the winter fishery the mean length has been has been relatively stable except for the winter 2002.Survey results from 1993 to 1999 indicate an increase in abundance until 1998. In 2001 and further in 2003 survey abundance index decreased significantly to the lowest observed. Since the decrease in catch rates is for all lengths, the decline is most probably associated with availability to the gear. Catch composition in the commercial fishery has changed significantly since the 1980s towards a higher exploitation of younger age groups, but has stabilized in recent decade. Upernavik: Landings increased from about 1 000 tons prior to 1992 to highest on record, 7 012 tons in 1998. Since then landings have decreased continually by more than 50% to 3 000 tons in 2003. No recent information is available the commercial fishery and no surveys have been carried out. Apart from total catches there is thus no information to evaluate present stock status. New fishing grounds in the northern part of the district are being exploited, however, little information exists from these areas.

Boje, J. and Lyberth, B. 2005. Survey calibration for Greenland halibut in Division 1A inshore. NAFO SCR documents 05/57: 8 p.

In order to calibrate catch efficiency of a newly initiated gillnet survey with a former longline survey in Disko Bay, NAFO Division 1A, parallel settings by the two gears were performed in 2001 and 2004. Gear efficiency was expressed as the ratio between standardized length distributions of the two gears. Variation in catch ratio by length was tested by use of a GLM model taking into account area and year effects. The model outlines that length is not a significant contributor to the overall model and the ratio relationship between the two gears within the length range 30 to 50 cm can therefore be assumed constant. This implies that longline catches from the longline survey back to 1993 in Disko Bay can be converted into gillnet equivalents and thereby the entire time series used for assessment of the stock component.

Boje, J. and Riget, F. 1987. Catch and size distribution of Greenland halibut, *Reinhardtius hippoglossoides* (Walb.) at Jakobshavn, West Greenland. NAFO SCR documents 87/33: 11 p.

Boje, J. and Riget, F. 1988. Maturity stages in March and August of Greenland halibut in Div. 1A, West Greenland. NAFO SCR documents 88/13: 7 p.

Boje, J. and Riget, F. 1989. Results of the 1986, 1987 and 1989 Greenland-Canada Greenland halibut otolith exchange. NAFO SCR documents 89/42: 3 p.

To comply with a future assessment on this stock age determination have recently been commenced by the Greenland Fisheries Research Institute. In order to validate age determination otoliths have been exchanged between Greenland (Denmark) and Canada. This paper summarizes results of the 1986, 1987 and 1989 comparison age readings.

Boje, J. and Riget, F. 1989. The fishery for Greenland halibut in Subarea 1. NAFO SCR documents 89/27: 8 p.

Length distribution of the 1988 catch in the commercial inshore fishery as well as the offshore fishery in Subarea 1 are presented.

Boje, J. and Simonsen, C.S. 2004. Settling and factors affecting 0-group distribution of Greenland halibut, *R. Hippoglossoides* (Walbaum), in West Greenland. ICES CM 2004/J:08: 1 p.

An important settling ground for Greenland halibut in an area at the northern part of Store Hellefisk Bank at West Greenland was investigated during a three month period in the late summer/early autumn in order to determine time of 0-group settling and evaluate abiotic and biotic factors that determine the location of settling and subsequent distribution of 1 and 2 year old fish. The study was performed by means of a small meshed trawl, an acoustic seabed classification and a core bottom sampler. The main part of the settling took place in late August and early September, although historic data shows some variation. Echosounder data was used to categorize seabed type into six classes. These data allowed us to conclude that the 0-group Greenland halibut preferred bottom substrate ranging from clay to silt, whereas 1 and 2 year old fish preferred clay sediment. The differences in abundance of early life stages between the two habitat types and possible associated factors affecting habitat preference are discussed.

Boje, J., Riget, F., and Simonsen, V. 1989. An analysis of genetic differentiation in Greenland halibut (*Reinhardtius hippoglossoides* W.) in the Northwest Atlantic. NAFO SCR documents 89/26: 8 p.

As part of a stock identification study of Greenland halibut frequencies of electrophoretically detectable protein loci were analyzed from six areas in the western North Atlantic in order to elucidate the genetic differentiation. Generally, differences in all ele frequencies are small between the samples. Concerning four polymorphic loci the phenotypic distribution for all six samples was in accordance with the expectations from the Hardy-Weinberg proportions. A trend of deficiency of heterozygotes indicates mixed populations. Differences in homogeneity of the allele frequencies between samples are interpreted as that the populations studied do not belong to the same breeding group. However, the genetic distances between the samples are too small to be interpreted as differentiation in local populations. Furthermore, the method of electrophoresis is sensitive to intermingling,which is expected to occur between the areas studied.

Boje, J., Riget, F., and Koie, M. 1990. Infestation of parasites in Greenland halibut in the Northwest Atlantic. NAFO SCR documents 90/36: 18 p.

As part of a stock identification study of Greenland halibut, the parasite fauna of Greenland halibut were analysed from six areas in the Northwest Atlantic in order to elucidate differences in parasite burden. Of the species found, three species of digeneans and five species of nematodes show irregularities in distribution pattern. The prevalence of these species indicate that in most cases the southern fiords of West Greenland were similar. However, there were some similarities between these samples and those from the Denmark Strait. The sample from Newfoundland has a unique parasite fauna, but there seems to be a decline from this sample to the Davis Strait and further onto the Denmark Strait.

Boje, J., Jørgensen, O.A., and Bech, G. 1994. An assessment of the Greenland halibut stock component in NAFO Subareas 0+1. NAFO SCR documents 94/59: 13 p.

The authors report that offshore effort levels in all subareas are in excess of what the Greenland halibut (*Reinhardtius hippoglossoides*) stocks can sustain.

Boje, J., Gundersen, A., and Woll, A. 1997. Gillnet selectivity in the fishery for Greenland halibut in East Greenland. ICES CM 1997/FF:04: 5 p.

Catches of Greenland halibut (*Reinhardtius hippoglossoides*) in East Greenland and Iceland have reached a considerably high level in the last decade due to increased effort mainly by trawlers. Associated with these high catches are a steady decrease in SSB towards a critical low level. This has led to serious concern about exploitation level as well as exploitation pattern on the resource. In order to evaluate the potential for gears which exploit older components of the Greenland halibut stock, a trial fishery with gillnets using 110 mm and 120 mm mesh sizes was carried out in August 1995. Although more than 7000 fish were caught by alternate use of the two mesh sizes no distinct mesh selection appeared. Due to difference in fishing power, an approximate selectivity factor was estimated at 6,86 by the method of Holt (1963), which is close to values seen for Greenland halibut elsewhere and for other flatfish.

Boje, J., Riget, F., and Koeie, M. 1997. Helminth parasites as biological tags in population studies of Greenland halibut (*Reinhardtius hippoglossoides* (Walbaum)), in the North-west Atlantic. ICES J. Mar. Sci. 54: 886-895.

As part of a stock identification study, the parasite fauna of 608 Greenland halibut, *Reinhardtius hippoglossides* (Walbaum) from six areas in the north-west Atlantic was examined. New records of parasite species for the Greenland area have been added by this study. No significant differences in prevalence were found between sexes or age groups of Greenland halibut. Three digeneans (*Brachyphallus crenatus, Steganoderma formosum and Stenakron vectusum*) and three nematodes (*Anisakis simplex, Ascarophis* sp., and *Contracaecum* sp.) showed irregularities in spatial infestation pattern and were therefore chosen as biological tags. Nonparametric discriminant analyses of the prevalence of these parasites indicated strong similarities between components off Labrador, Davis Strait, and in the fjords of Umanak at West Greenland. Greenland halibut in south-west Greenland fjords appeared to be isolated, as does the component in the Denmark Strait. This general pattern adds further support to previous investigations on stock structure of Greenland halibut in the North-west Atlantic.

Boje, J., Albert, O.T., Bowering, W.R., Brodie, B., Gundersen, E., Hjörleifsson, E., Høines, Å., Junquera, S., Jørgensen, O.A., Reinert, C.S., and Treble, M. 2002. Greenland halibut biology and population dynamics : state of the art identification of research needs : based on a Nordic Workshop. Nord 2002:534.

The objectives of the workshop were to share and compile information on Greenland halibut with respect to ongoing research activities, laboratory strategies on research and monitoring, perception of biology and stock dynamics, and future needs.

Bondarenko, M.V., Krovnin, A.S., and Serebryakov, V.P. 2003. Ranging year-class strength and survival rates during early life history of the Barents Sea food fishes to establish biological reference points and evaluate environmental effects. ICES CM 2003/Y:09: 107 p.

Survival index (SI) of a year class in early life history is defined as the ratio of abundance of fish at age 3 to the total number of eggs should be spawned in a given year, i.e., population fecundity (PF), or to the spawning stock biomass (SSB). SI is considered here to be an integrated indicator of survival conditions during early life, i.e., periods of egg, larval and fry development. Ranking of SI by means of cluster analysis revealed three types of survival conditions favourable, moderate and unfavourable. The corresponding values of SI (*106) to these three types of conditions were estimated in spring-spawning Norwegian herring as 152.49, 28.27, 4.97; in Northeast Arctic cod 16.94, 6.39, 3.05; in Northeast Arctic haddock 24.18, 8.55, 2.00; and in Greenland halibut of the Barents Sea 219.29, 101.24, 45.60. Regression equations were obtained describing dependence of recruitment on spawning stock size in three types of survival conditions for each of the stocks considered. Three levels of PF and SSB safe, minimal required and critical were calculated corresponding to the types of survival conditions in the food fish populations studied. An attempt was made to collate long-term changes in survival conditions (logarithm of SI) with the same of some indicators (three main components) of ambient conditions in the ocean (IO). Unidirectional and even synchronous trends in fluctuations of SI and IO obtained as a result of the collation analysis allows for not only to describe the survival dependence on ambient conditions in quantitative terms, but also introduce corrections to the values of biological reference points in accordance with the prognosis of hydrological conditions. In this way, if it is true that the warm period in the Eastern North Atlantic is close to its end, very infrequent favourable survival conditions for Northeast Arctic cod should be expected. Hence it follows that calculations of the biological reference point as is SSB for conservation should be performed based on SI values specific for unfavourable and moderate conditions of survival in early life history. Long-term changes of SI correlate well with the long-term climate changes in the North Atlantic.

Borkin, I.V. 1983. Rezul'taty issledovanij ikhtiofauny v rajone Zemli Frantsa-Iosifa i k severu ot Shptsbergena [Results of studies of ichthyofauna off Franz Josef Land and in the area north of Spitsbergen]. KOL'SK. FIL. AN S.S.S.R., USSR.
[In Russian]

Young Greenland halibut *Reinhardtius hippoglossoides* was found to be abundant on the shelf of Franz Josef Land and in Franz Victoria Trench. The data on Arctic cod *Boreogadus saida*, suggested formation of the species concentrations on the shelf of Franz Josef Land in summer and autumn. As a result of surveys the check list of the ichthyofauna was doubled. Most of the species recorded belong to the Arctic complex. The occurrence of typically boreal species is attributed to the warming effect of the West Spitsbergen Current contributing to the penetration of the North Arctic fishes into high latitudes of Arctic Regions.

Borkin, I.V. 1991. Ichthyoplankton of the West Spitsbergen coastal waters. Vopr. Ikhtiol. 31: 680-685.
[In Russian]

Information on the early stages of life of commercial fish encountered in the coastal waters of Spitsbergen is limited and mainly concern the Arctic cod *Boreogadis-saida*, whose biology and ecology have rarely been studied. In autumn an accumulation of prespawning cod is noted, and in summer there is an accumulation of fry. Only in recent years have there been reports of yolk-sac larvae and larvae. The task of this study was to determine the locations and times of spawning of various fish species, as well as to discover the range limits and habitat conditions of larvae of certain fish in the northwestern part of the Barents Sea: *Boreogadus-saida, Sebastes-mentella, Mallotus-*

villosus-villosus, Gadus-morhua-morhua, Melanogrammus-aeglefinus, Hippoglossoides-platessoides-limandoides, and *Reinhardtius-hippoglossoides*.

Borkin, I.V. 1992. Ichthyoplankton of the coastal waters of western Spitsbergen. J. Ichthyol. 32: 145-153.

The findings are presented of a study conducted to determine the place and period of spawning of some fish species in the coastal waters of western Spitsbergen; observations were also made regarding the limits of distribution and conditions of existence of the larvae of the most common species, namely *Boreogadus saida, Sebastes mentella, Mallotus villosus villosus, Gadus morhua morhua, Melanogrammus aeglefinus, Hippoglossoides platessoides limandoides* and *Reinhardtius hippoglossoides*.

Borovkov, V., Kovalev, S., Savvatimsky, P., Rikhter, V.A., and Sigaev, I.K. 1992. Russian research report for 1991. NAFO SCS documents 92/12: 21 p.

Borovkov, V., Gorchinsky, K., Kovalev, S., Savvatimsky, P., Rikhter, V.A., and Sigaev, I.K. 1993. Russian research report for 1992. NAFO SCS documents 93/10: 14 p.

Boudreau, P., Roberge, M.M., Hurtubise, S., and Lambert, J.D. 1994. Canadian research report for 1993. NAFO SCS documents 94/10: 24 p.

Bourdages, H., Archambault, D., Morin, B., Fréchet, A., Savard, L., Grégoire, F., and Bérubé, M. 2002. Résultats préliminaires du relevé multidisciplinaire de poissons de fond et de crevette d'août 2002 dans le nord du golfe du Saint-Laurent = Preliminary results from the groundfish and shrimp multidisciplinary survey from August 2002 in the northern Gulf of St. Lawrence. Canadian Science Advisory Secretariat research document 2002/090: 69 p.
[in English and French in parallel columns]

In 2002, the groundfish and shrimp multidisciplinary survey in the northern Gulf took place between August 1st and September 1st. A total of 207 fishing tows were conducted over the entire area of which 190 were successful, which corresponds to 76% of the initial objective of 250 tows. Summary results concerning biomass and abundance, length frequencies and distribution of catch rates are presented for 13 species, including the four that are targeted by the survey (cod, Greenland halibut, redfish and shrimp). Results from 2002 are compared with those from previous years in order to have an indication of the trends for the 13 years time series. However results from 2002 are preliminary and must be considered as such pending laboratory analysis and completion of the validation of data. According to these preliminary results, biomass indices for cod, redfish, witch flounder and American plaice are very low in the northern Gulf while those of shrimp and Greenland halibut have remained high. A general decline in catches is observed for the majority of species along the West Coast of Newfoundland. However, the coverage of this area in 2002 was restricted due to frequent gear damage.

Bourdages, H., Archambault, D., Morin, B., Fréchet, A., Savard, L., Grégoire, F., and Bérubé, M. 2003. Résultats préliminaires du relevé multidisciplinaire des poissons de fond et de crevette d'août 2003 dans le nord du golfe du Saint-Laurent = Preliminary results from the groundfish and shrimp multidisciplinary survey from August 2003 in the northern Gulf of St. Lawrence. Canadian Science Advisory Secretariat research document 2003/078: 68 p.
[in English and French in parallel columns]

In 2003, the multidisciplinary groundfish and shrimp survey in the northern Gulf occurred from August 1st to the 31st. A total of 205 fishing tows were carried out during the mission, of which 196 were successful, representing 78 % of the initial 250 tow objective.

The initial results from biomass and abundance indexes, from length frequency distribution, and from catch rate distribution, are presented for 13 species, including the four species targeted by the survey (cod, Greenland halibut, redfish, and shrimp). The 2003 results are compared to the results from previous years in order to show trends observed over the 14 year period. However, the 2003 results are preliminary and must be treated accordingly until laboratory analysis and data validation have been completed. According to preliminary results, the biomass indexes for many species, such as cod, turbot, shrimp, Atlantic halibut, capelin (dispersal index), thorny skate, white hake, witch flounder and American plaice, indicated a increase and in some cases, the highest levels of the 1990-2003 period were reached, while others species had low biomass index levels in 2002. For other species, such as redfish, black dogfish, and longfin hake, the biomass index remained stable compared to previous years. Finally, a general increase in the number of catches for most of the species analyzed in this study was observed for the entire area covered by the survey.

Bourdages, H., Archambault, D., Morin, B., Fréchet, A., Savard, L., Grégoire, F., and Dufour, R. 2004. Résultats préliminaires du relevé multidisciplinaire des poissons de fond et de crevette D'AÔUT 2004 dans le nord du golfe du Saint-Laurent = Preliminary results from the groundfish and shrimp multidisciplinary survey from August 2004 in the northern Gulf of St. Lawrence. Canadian Science Advisory Secretariat research document 2004/112: 40 p.
[Text in English and French in parallel columns]

Boutin, E. 1992. Fiches techniques d'especes commerciales. Document de recherche (Québec (Province). Ministère de l'agriculture, des pêcheries et de l'alimentation. Direction de la recherche scientifique et technique); 92/08: 23 p.
[In French]

Bowering, W.R. 1977. Trends in the Greenland halibut fishery in Subarea 2 and Divisions 3K and 3L. ICNAF Res. Doc. 77/VI/11: 14 p.

Bowering, W.R. 1978. Age and growth of the Greenland halibut, *Reinhardtius hippoglossoides* (Walbaum), in ICNAF Subareas 2-4. Int. Comm. Northwest Atl. Fish. Stat. Bull. 13: 5-10.

Length and age distributions and growth curves are presented for Greenland halibut of ICNAF Subareas 2-4. The largest and oldest Greenland halibut were caught in the most northerly areas. There was little difference in growth rate between males and females for sections of the growth curves presented here. The growth rate generally increased from north to south.

Bowering, W.R. 1978. The distribution of Greenland halibut in Statistical Area "0". ICNAF Res. Doc. 78/VI/38: 6 p.

Bowering, W.R. 1978. The exploitation of the Greenland halibut stock complex of ICNAF Subarea 2 and Divisions 3KL. ICNAF Res. Doc. 78/VI/39: 14 p.

Bowering, W.R. 1979. A development interest for Greenland halibut in the Gulf of St. Lawrence. CAFSAC Res. Doc. 79/9: 12 p.

Bowering, W.R. 1979. Recruitment prospects for Greenland halibut in Statistical Area 0. ICNAF Res. Doc. 79/VI/60: 6 p.

Bowering, W.R. 1979. The Greenland halibut fishery on the continental shelf of ICNAF Subarea 2 and Div. 3KL. ICNAF res. doc. 79/71: 14 p.

Bowering, W.R. 1980. Fecundity of Greenland halibut, *Reinhardtius hippoglossoides* (Walbaum), from southern Labrador and southeastern Gulf of St. Lawrence. J. Northwest Atl. Fish. Sci. 1: 39-43.

The fecundity of Greenland halibut from the southern Labrador and southeastern Gulf of St. Lawrence areas in 1976-78 was found to be highly correlated with length and to a lesser extent with age, the relationships being best described in terms of log-log regressions. The fecundity-length relationship for the southern Labrador area differed significantly from that for the southeastern Gulf of St. Lawrence both in the rate of egg production and the number of eggs produced, but no differences were found in the fecundity-age relationships. The higher fecundity of fish in the southeastern Gulf of St. Lawrence may be due to their becoming mature at considerably smaller sizes than in the southern Labrador areas. Annual variation in fecundity was not evident in the data for 2 yrs from southern Labrador.

Bowering, W.R. 1980. Stock assessment and abundance of Greenland halibut in the Canadian north Atlantic (Subarea 2 and Divisions 3K and 3L) NAFO SCR documents 80/VI/96:26p.

Bowering, W.R. 1980. The Greenland halibut fishery in the Gulf of St. Lawrence. CAFSAC Res. Doc. 80/24: 18 p.

Landings have averaged 600-1000 t up to 1974 and subsequently increased to 4000 t in 1977 and 1978 to a high of 10,000 t in 1979. The fishery is made up of >80% 6-10 yr old fish very similar to the strong recruiting year-classes found in the Labrador-northeast Newfoundland stock. Biomass surveys indicated stability in division 4S with substantial reductions in biomass in Division 4R. There was no estimate of biomass in Division 4T which accounted for 60% of the catch in 1979. Fishing mortality estimates were similarly high from both commercial and research data. It was determined that the levels of fishing mortality do not reflect estimates of stock abundance in the Gulf of St. Lawrence unless there is significant immigration from other areas.

Bowering, W.R. 1981. Greenland halibut in the Gulf of St. Lawrence - from immigrants to emigrants. CAFSAC Res. Doc. 92/99: 11 p.

An allozyme study was conducted to determine if Greenland halibut from the Gulf of St. Lawrence and the Northwest Atlantic area belong to genetically differentiated populations. Genetic variations were studied at 13 loci coding for 10 proteins. Results show a low degree of genetic differentiation in this species. Genetic differentiation among age groups within sampling sites is also weak, suggesting that the observed structure is temporally stable.

Bowering, W.R. 1982. Certain biological characteristics of Greenland halibut in the northwest Atlantic and their significance for stock identification. Thesis (M.Sc.) Memorial University of Newfoundland, St. John's, Nfld. 118 p.

Bowering, W.R. 1982. Minimum trawlable biomass estimates of Greenland halibut in NAFO Division 2G and 2H from post-stratified groundfish surveys. NAFO SCR documents 82/100: 8 p.

Bowering, W.R. 1982. Population dynamics of Greenland halibut in the Gulf of St. Lawrence. J. Northwest Atl .Fish. Sci. 3: 141-147.

Greenland halibut, *Reinhardtius hippoglossoides*, in the Gulf of St. Lawrence are generally concentrated during the winter in deep water of the Laurentian Channel off Southwest Newfoundland. They are dispersed during the summer, but small concentrations are found in the mouth of the St. Lawrence River west of Anticosti Island.

The fishery for this species in the Gulf increased rapidly from 1,500 tons in 1975 to nearly 9,000 tons in 1979 and declined to 3,000 tons in 1981, the catches being comprised of age-groups corresponding to those of very successful year-classes off Labrador and eastern Newfoundland. The drastic reduction in abundance since 1978, the lack of observable recruitment, the recent decline in catches, and peculiarities in certain biological characteristics indicate that substantial recruitment to the fishery in the Gulf of St. Lawrence may come from areas outside the Gulf, possibly through the Strait of Belle Isle.

Bowering, W.R. 1982. Stock identification studies of Greenland halibut (*Reinhardtius hippoglossoides*) in the Northwest Atlantic from tagging experiments. NAFO SCR documents 82/9/78: 18 p.

The implications of management strategy by three separate compartments with regard to the accuracy of international fish stock assessment of this species have recently become an important consideration by fisheries management. This is a result of these recent hypotheses that the stock complex from Davis Strait to the northern Grand Bank, is a single discrete spawning unit, as well as the evidence of considerable mixing of two stocks in the Gulf of St. Lawrence. The management bodies of NAFO and CAFSAC have therefore recommended considerable research be placed into the accurate delineation of Greenland halibut stocks in the northwest Atlantic, in order to elucidate the problem and enhance management effectiveness of this very valuable resource. This paper will highlight results of Greenland halibut stock identification studies by tagging experiments carried out mainly due to the foregoing recommendation as well as review other independent stock identification studies of Greenland halibut.

Bowering, W.R. 1983. Age, growth, and sexual maturity of Greenland halibut, *Reinhardtius hippoglossoides* (Walbaum), in the Canadian Northwest Atlantic. Fish. Bull. (Wash. D.C.) 81: 599-611.

Age composition of Greenland halibut in the eastern area ranged up to 14 yr for males and up to 18 yr for females; most fish, however, were age 9 and females >age 12 were completely absent from the catch. Growth curves for all areas show females growing faster than the males, particularly in the older ages, while mean size at age indicates little difference up to ages 8-12. Fish from the Gulf of St. Lawrence exhibited the fastest growth rate and fish from Baffin Bank the slowest throughout the range. Onset of maturity of female Greenland halibut from the Gulf of St. Lawrence occurred at a much smaller size and over a more narrow range of sizes than in other more northerly areas. In the Labrador-eastern Newfoundland area onset of maturity occurred at smaller sizes, moving progressively northward. This shift of the maturity curves is believed to be a result of mature fish migrating towards the spawning ground. The Baffin Bank maturity curve is similar to that of Nain Bank in the mid-Labrador area, but since Baffin Bank is so near the spawning ground and heavily influenced by the cold polar current, most maturing fish are likely to be in deep warmer water outside the fishable range; i.e. the curve may be biased to the right.

Bowering, W.R. 1983. By-catch levels of Greenland halibut in the roundnose grenadier directed fishery of NAFO Subareas 2+3. NAFO SCR documents 83/28: 4 p.

This document will present the available information on by-catches of Greenland halibut in the roundnose grenadier fishery by GDR and the USSR as reported by the Foreign Observer Program, Newfoundland Region, in 1981 and 1982. Data obtained from research vessel surveys will also be discussed.

Bowering, W.R. 1983. Le turbot du Groenland. Le monde sous-marin 24: 5 p.

Bowering, W.R. 1984. Distribution and relative abundance of the Labrador-eastern Newfoundland stock complex of Greenland halibut (*Reinhardtius hippoglossoides*). NAFO SCR documents 84/61: 14 p.

This paper will describe the distribution and relative abundance of the Labrador-eastern Newfoundland stock complex of Greenland halibut as it relates to geographical position, depth, and bottom temperature. The analysis is based on extensive survey data collected by Canada, the Soviet Union, the German Democratic Republic, and the Federal Republic of Germany performing groundfish surveys in general or Greenland halibut surveys in particular.

Bowering, W.R. 1984. Le turbot du Groenland. Le monde sous-marin 24: 5 p.

Bowering, W.R. 1984. Turbot (Greenland halibut). Underwater world 24: 5 p.

Bowering, W.R. 1984. Migrations of Greenland halibut, *Reinhardtius hippoglossoides*, in the Northwest Atlantic from tagging in the Labrador-Newfoundland region. J. Northwest Atl. Fish. Sci. 5: 85-91.
[NAFO Special Session on "Stock Discrimination in Marine Fishes and Inverterbrates of the Northwest Atlantic, Dartmouth, N.S. (Canada), 8-10 Sep 1982]

Migratory patterns of Greenland halibut (*Reinhardtius hippoglossoides*) in the Northwest Atlantic were investigated by two tagging experiments in 1969 and 1971 using longlines to capture the fish and three experiments in 1979-80 using otter trawls. Of nearly 24,400 tags applied, only 1.3% have been recovered to the end of 1983, the low recovery rate being attributed partly to the low level of offshore fishing activity and partly to high tagging mortality of fish caught in otter trawls. Results of the White Bay experiment in 1969 showed some movement of Greenland halibut from the tagging area to offshore deepwater areas of Labrador and Davis Strait, although many of the recaptures were in the general area of tagging. However, the Trinity Bay and Fortune Bay experiments in 1971 and 1979 respectively indicated little movements from the tagging sites. The Funk Island Bank experiments in 1979 and 1980 indicated substantial movement to coastal waters of northeastern Newfoundland in summer. From tagging experiments off Labrador in 1980, the few returns indicated eastward movement to the deepwater areas of the continental slope, with one recapture from deep water off the northern tip of Labrador.

Bowering, W.R. 1984. The fishery for Greenland halibut in NAFO Subarea 0+1. NAFO SCR documents 84/60: 5 p.

Bowering, W.R. 1987. A newly developed stratification scheme for selected areas in NAFO Subareas 0 and 1. NAFO SCR documents 87/25: 5 p.

Bowering, W.R. 1987. A newly developed stratification scheme for NAFO Divisions 2G and 2H. NAFO SCR documents 87/23: 6 p.

Bowering, W.R. 1987. Distribution and abundance of Greenland halibut in Davis Strait (NAFO Subareas 0 and 1) from a Canadian research vessel survey in 1986. NAFO SCR documents 87/22: 10 p.

Bowering, W.R. 1988. An analysis of morphometric characters of Greenland halibut (*Reinhardtius hippoglossoides*) in the Northwest Atlantic using a multivariate analysis of covariance. Can. J. Fish. Aquat. Sci. 45: 580-585.

Eleven morphometric characters were measured on samples of Greenland halibut (*Reinhardtius hippoglossoides*) from eight different areas of high Greenland halibut abundance throughout the Northwest Atlantic from Davis Strait to the northern Grand

Bank. These data were then analysed using a multivariate analysis of covariance technique with the aim of using the results to delineate Greenland halibut stocks throughout the study area. The results suggested that each area examined may very well support a separate stock. However, given the state of knowledge of this resource, this was not believed to be truly the case. Alternative explanations for the results are discussed.

Bowering, W.R. 1988. Biomass estimates of Greenland halibut in NAFO Div. 2GH from post-stratified and stratified Canadian groundfish surveys. NAFO SCR documents 88/40: 12 p.

Bowering, W. R. 1993. Turbot (Greenland halibut) [Le turbot du Groenland]. Underwater world 24, 5 p. [Revised edition]

Bowering, W.R. 1999. Ecology, fisheries and management of Greenland halibut (*Reinhardtius hippoglossoides* (Walbaum)) in the Canadian Northwest Atlantic. Dept. of Fisheries and Marine biology, University of Bergen (Norway).Thesis (Ph.D.) University of Bergen, Bergen, Norway

The Greenland halibut (*Reinhardtius hippoglossoides*, Walbaum) is the most extensively distributed flatfish species in the North Atlantic. Due to its deepwater habitat its distribution is rather continuous from Canadian waters in the western Atlantic to the Barents Sea in the Northeast Arctic. It has been the subject of intensive fishing throughout the area in the coastal state waters of Canada, Greenland, Iceland, Faeroe Islands, Norway and Russia especially since the 1960s. With the collapse of most major groundfish resources in Northwest Atlantic, Greenland halibut now has become the most important groundfish fishery in this area. This thesis will present results of seven (7) scientific papers on Greenland halibut based on research conducted primarily at the Northwest Atlantic Fisheries Center in St. John's, Newfoundland, Canada. All papers have been published in the primary literature and are referred to by the Roman numerals I to VII throughout the text of the synthesis.

Bowering, W.R. 2000. Trends in distribution, biomass and abundance of Greenland halibut (*Reinhardtius hippoglossoides*) in NAFO Subarea 2 and Divisions 3KLMNO from Canadian research vessel surveys during 1978-99. NAFO SCR documents 00/12: 42 p.

Greenland halibut are widely distributed throughout the Labrador and eastern Newfoundland area. In the late 1970's and throughout most of the 1980's they were found in relatively high abundance along the deep slopes of the continental slopes particularly in Division 2G. They were similarly plentiful in the deep channels running between the fishing banks especially in Divisions 2H and 2J and to a significant degree i Division 3K. By 1991 distribution in the northern areas was greatly reduced and most of the resource was located in Division 3K and along the north slope of Division 3L and to some degree 3N. By 1996-99 distribution to some traditional areas off southern Labrador and northeast Newfoundland again began to occur, however, areas northward of the northern half of Division 2J still remain low in abundance. In Divisions 2J and 3K where most of the Greenland halibut resource resides the stock biomass was relatively stable up until the mid 1980's after which it declined substantially to reach an all time low in the early 1990's with the disappearance of older fish from the population. From about 1995 the stock showed considerable recovery and continues to improve based upon several successive good year-classes particularly 1993-95. Nevertheless, the fishable biomass and spawning stock biomass remain well below historic highs but should improve as these year-classes add growth and reach spawning age.

Bowering, W.R. 2001. Population trends in the Greenland halibut (*Reinhardtius hippoglossoides*) resource of NAFO Subarea 2 and Divisions 3KLMNO based on Canadian research vessel survey results during 1978-2000. NAFO SCR documents 01/39: 42 p.

Bowering, W.R. 2002. Greenland halibut (*Reinhardtius hippoglossoides*) in NAFO Subarea 2 and Divisions 3KLMNO: stock trends based on Canadian research vessel survey results during 1978-2001. NAFO SCR documents 02/24: 40 p.

Greenland halibut (*Reinhardtius hippoglossoides*) are widely distributed throughout the Labrador-eastern Newfoundland area. During the late-1970s and most of the 1980s they were found in relatively high abundance along the deep slopes of the continental shelf particularly in Division 2G. They were similarly plentiful in the deep channels running between the fishing banks especially in Div. 2H, 2J and 3K. By 1991 distribution in the northern areas was greatly reduced and most of the resource was located in Div. 3K and along the north slope of Div. 3L and to some degree Div. 3N. By 1996-2001 distribution to some areas of historically high abundance off southern and central Labrador as well as northeast Newfoundland again began to occur. In Div. 2J and 3K where most of the Greenland halibut resource resides the stock biomass was relatively stable until the mid-1980s after which it declined substantially to reach an all time low in the early-1990s with the disappearance of older fish from the population. From about 1995 the stock showed considerable recovery and continued to improve to 1999 based upon several good successive year-classes particularly 1993-95. The fishable biomass (>30 cm) has declined somewhat since 1999 while the spawning stock biomass estimates remain well below those of the 1980s.

Bowering, W.R. and Atkinson, D.B. 2004. Capelin stocks in Canadian and NAFO waters. *In* Management strategies for commercial marine species in northern ecosystems: proceedings of the 10th Norwegian-Russian Symposium, Bergen, Norway, 27-29 August 2003. *Edited by* Bjordal, Å., Gjøsaeter, H., and Mehl, S. IMR/PINRO Joint Report Series; 1. pp. 25-26.

Historically, capelin (*Mallotus villosus*) has been the most important forage species for high-end predators of the Northwest Atlantic Ocean. Such predators include many commercially important groundfish species, especially cod, Greenland halibut and American plaice. Others include a variety of marine mammals and sea birds. Although four stocks of capelin have been identified in the Canadian Northwest Atlantic, two major stocks have been widely studied and heavily fished. Historically, the largest stock is found from southern Labrador to the northern Grand Bank (NAFO Divisions 2J, 3KL). This stock comprises the center of capelin distribution in the Northwest Atlantic. It spends most of its life cycle in the offshore but spawns primarily on or just off the beaches of inshore locations. The other major capelin stock is found on the southern Grand Bank (NAFO Division 3NO) where it spends its entire life cycle spawning on the southeastern Grand Bank in about 60 m of water in an area known as the Southeast Shoal. Both stocks spawn at about the same time (June-July). The two stocks mix somewhat during their time offshore and are known to move outside Canada's 200-mile limit, although most spawning occurs in the Canadian zone. There have been several changes in the biology of capelin that first became evident in the early 1990s and have persisted until the present. These include: 1) later spawning on the beaches; 2) increased off beach spawning; 3) large-scale changes in the distribution within the normal range of distribution as well as to areas in which capelin would have not normally occurred, such as Flemish Cap and the Scotian Shelf; 4) smaller fish size accompanied by poorer condition; and, 5) occurrence deeper in the water column with reduced diurnal activity. These changes in biological characteristics were initially thought to have occurred as a result of the very cold temperatures experienced during the early 1990s. However, the changes in biology have persisted despite temperatures returning to more normal levels.

Bowering, W.R. and Atkinson, D.B. 2004. Greenland halibut stocks in Canadian and NAFO waters. *In* Management strategies for commercial marine species in northern ecosystems: proceedings of the 10th Norwegian-Russian Symposium, Bergen, Norway, 27-29 August 2003. *Edited by* Bjordal, Å., Gjøsaeter, H., and Mehl, S., IMR/PINRO Joint

Report Series; 1. pp. 79-80.

Greenland halibut (*Reinhardtius hippoglossoides)* is a large Pleuronectiform flatfish and because of its unique characteristics, it is the only species in the genus Reinhardtius. Among its more interesting features are 1) dark coloration on both sides, unlike almost all other flatfish species, which are usually white on the underside; 2) that the left eye is not fully migrated, giving it an unusually wide range of peripheral vision; 3) an elongated shape and muscle arrangement which are characteristic of a powerful swimmer (often observed on the surface of the sea) and 4) studies of its physiology indicate it can control its gravitational position when swimming either vertically or horizontally. Greenland halibut in the Northwest Atlantic are widely distributed from high in the Arctic between Canada and Greenland to as far south as the Scotian Shelf, although it is most abundant from the eastern Grand Bank and Flemish Cap beyond the Canadian 200-mile limit and north to the Davis Strait. The Greenland halibut is a deepwater species with higher densities concentrated primarily at depths of about 500-1200 meters along the continental slope and within the deep channels running between the fishing banks on the continental shelf as well as the deep inshore bays of eastern Newfoundland and the fjords of Greenland and Baffin Island. In recent years, with the advances in modern fishing technology, it has been found to be commercially abundant in some areas as deep as 1500-1800 meters, particularly in NAFO Division 3LMN throughout the Flemish Pass. It has also been caught in longline investigations as deep as 2200 meters, both off West Greenland in the north and in the Flemish Pass. While the more extensive distribution is along the eastern continental shelf, it is also of commercial importance in the Gulf of St. Lawrence and exists in limited quantities along the south Newfoundland coast, Fortune Bay and in the Laurentian Channel.

Bowering, W.R. and Atkinson, D.B. 2004. Shrimp stocks in Canadian and NAFO waters. *In* Management strategies for commercial marine species in northern ecosystems: proceedings of the 10th Norwegian-Russian Symposium, Bergen, Norway, 27-29 August 2003. *Edited by* Bjordal, Å., Gjøsaeter, H., and Mehl, S. IMR/PINRO Joint Report Series; 1. pp. 117-118.

In the Northwest Atlantic, commercial shrimp populations consist primarily of *Pandalus borealis* and to a much lesser extent *Pandalus montagui.* In the Northwest Atlantic they are distributed from the Davis Strait in the Arctic to the Gulf of Maine off the Northeastern United States, usually in areas where the ocean floor is soft and muddy and where temperatures near the bottom range from about 2 to 6 degree C. These conditions are very common particularly throughout the Newfoundland and Labrador offshore area within a depth range of about 150 - 600 m, thus providing a vast area of suitable habitat. Both species are known as protandric hermaphrodites which means they first mature as males, mate as males for one to several years and then change sex and spend the rest of their lives as mature females. Although the age of shrimp is difficult to determine, they have been estimated to live for more than eight years in some areas. Some northern populations exhibit slower rates of growth and maturation but greater longevity results in larger maximum size. Being at the lower end of the food chain they are important prey for many species such as Atlantic cod, Greenland and Atlantic halibut, skates, wolffish, snow crabs and harp seals. There are five management areas from Baffin Island in the Arctic to the Grand Bank to the south, referred to as "Shrimp Fishing Areas" or SFAs. The most northerly area, SFA 1 off northern Baffin Island, straddles the boundary between Canada and Greenland and is therefore managed bilaterally by the two countries on the basis of scientific advice received from the NAFO Scientific Council. SFAs 2 and 4-6 are distributed from southern Baffin Island to eastern Newfoundland and are exclusively within Canadian waters. They are managed by Canada as the coastal state on the basis of scientific advice from the Science Branch Sector of the Canadian Department of Fisheries and Oceans. SFA 7 straddles the Canadian 200-mile limit on the eastern Grand Bank adjacent to Flemish Cap, which comprises another shrimp management area. The

latter two areas are managed by the NATO Fisheries Commission on the basis of advice of the NAFO Scientific Council. With the exception of the Flemish Cap management area, which is managed by effort limits, all other areas are managed using quotas.

Bowering, W.R. and Baird, J. 1980. Greenland halibut and witch flounder on the Flemish Cap (NAFO Division 3M). NAFO SCR documents 80/85: 11 p.

Bowering, W.R. and Brodie, W.B. 1981. Stock assessment of Greenland halibut in NAFO Subarea 2 and Divisions 3KL with projected catches for 1982. NAFO SCR documents 81/6/64: 17 p.

Bowering, W.R. and Brodie, W.B. 1982. The Greenland halibut fishery in NAFO Subarea 2 and Divisions 3KL. NAFO SCR documents 82/67: 13 p.

Bowering, W.R. and Brodie, W.B. 1983. An evaluation of the Greenland halibut (*Reinhardtius hippoglossoides)* stock complex in NAFO Subareas 2 and Divisions 3KL. NAFO SCR documents 83/55: 17 p.

Bowering, W.R. and Brodie, W.B. 1984. An assessment of the Greenland halibut (*Reinhardtius hippoglossoides*) stock complex in NAFO Subarea 2 and Division 3KL. NAFO SCR documents 84/VI/62 : 19 p.

Bowering, W.R. and Brodie, W.B. 1985. The status of the Greenland halibut (*Reinhardtius hippoglossoides*) stock in NAFO Subarea 2 and Divisions 3KL. NAFO SCR documents 85/43: 20 p.

Bowering, W.R. and Brodie, W.B. 1986. An evaluation of the status of Greenland halibut *(Reinhardtius hippoglossoides*) in NAFO Subarea 2 and Divisions 3KL. NAFO SCR documents 86/21: 24 p.

Bowering, W.R. and Brodie, W.B. 1987. The Greenland halibut resource in the Labrador and Eastern Newfoundland area (NAFO Subarea 2 and Divisions 3K and 3L). NAFO SCR documents 87/45: 18 p.

Bowering, W.R. and Brodie, W.B. 1988. A review of the status of the Greenland halibut resources in NAFO Subarea 2 and Divisons 3K and 3L. NAFO SCR documents 88/69: 23 p.

Bowering, W.R. and Brodie, W.B. 1989. An evaluation of the status of the Greenland halibut resources in NAFO Subareas 2 and Divisions 3K and 3L. NAFO SCR documents 89/61: 20 p.

Results of stratified-random groundfish fall surveys for Greenland halibut in Div. 2J, Div. 3K and Div. 3L are presented as mean weight (kg) per set per stratum. Biomass was estimated for most missing strata using a multiplicative analysis model. Stratified mean numbers per set at age are shown.

Bowering, W.R. and Brodie, W.B. 1990. An assessment of the Greenland halibut stock component in NAFO Subarea 2 and Divisions 3K and 3L. NAFO SCR documents 90/51: 21 p.

Results of stratified-random groundfish fall surveys for Greenland halibut in Div. 2J, Div. 3K and Div. 3L are presented as mean weight per set per strata. Biomass was estimated for most missing strata using a multiplicative analysis model. Trends in biomass by division as well as the three divisions combined are presented. Stratified mean numbers per set at age are shown. A comparison of relative year-class strengths at age 5 in Div. 2J, 3K, and 3L are presented. Catch numbers and weights at area were calculated in the

usual manner for the 1989 Canadian fishery only. Results of the sequential population analysis in population numbers and fishing mortality are shown.

Bowering, W.R. and Brodie, W.B. 1991. Distribution of commercial flatfishes in the Newfoundland-Labrador region of the Canadian Northwest Atlantic and changes in certain biological parameters since exploitation. Neth. J. Sea. Res. 27: 407-422.

The fisheries for witch flounder *Glyptocephalus cynoglossus*, American plaice *Hippoglossoides platessoides*, Greenland halibut *Reinhardtius hippoglossoides* and yellowtail flounder *Limanda ferruginea* are made up 11 separate management units. Witch flounder is a relatively deep-water species, predominant at depths of 184-366 m and prefers temperatures in the range 2.0-6.0[deg]C. It reaches its northern limits at Hamilton Bank, near S Labrador, but is otherwise found throughout the southern range of the study area. American plaice is a more shallow-water species, preferring colder water. It is most abundant in depths of 90-250 m and bottom temperatures of -0.5[deg]C to 2.5[deg]C. It is found throughout the study area, but occurs in higher concentration on the tops of hard banks. Greenland halibut prefers depths of 500-1000 m and temperatures of 0.0-4.0[deg]C. It is most abundant in areas north of the Grank Bank along the continental slope and deep channels running between the fishing banks. Yellowtail flounder prefers depths of 37-82 m where temperatures are in the range 3.0-5.0[deg]C. The main area of abundance is on the SE Grand Bank. All species exhibit reductions in the age range of the respective populations since the beginning of commercial exploitation. As well, there have been increases in the growth rates and reductions in the age at maturity, with a few exceptions.

Bowering, W.R. and Brodie, W.B. 1995. Greenland halibut (*Reinhardtius hippoglossoides*). A review of the dynamics of its distribution and fisheries off eastern Canada and Greenland. *In* Deep-water fisheries of the North Atlantic Oceanic Slope. *Edited by* A.G.Hopper. Kluwer Academic Publishers, Dordrecht, The Netherlands. pp. 113-160.

Greenland halibut is distributed throughout the deep waters of the Northwest Atlantic from as far north as 78 degree N to as far south as the Grand Bank and Flemish Cap with no apparent break in the continuity of its distribution along the continental slope. It is also found in the fjords of West Greenland and the deepwater bays of eastern Newfoundland and the Gulf of St. Lawrence. The biomass of the stock has been declining since the early 1980's although catches during recent years have reached unprecedented levels. This is mainly due to increased fishing effort primarily in Flemish Pass, Davis Strait and at West Greenland.

Bowering, W.R. and Brodie, W.B. 1999. Distribution of commercial flatfishes in the Newfoundland-Labrador region of the Canadian northwest Atlantic and changes in certain biological parameters since exploitation. *In* Ecology, fisheries and management of Greenland halibut (*Reinhardtius hippoglossoides* (Walbaum)) in the Canadian Northwest Atlantic. *Edited by* W.R.Bowering. University of Bergen (Norway). Thesis (Ph.D.) University of Bergen, Bergen, Norway

The flatfishes of the Newfoundland-Labrador region are a very significant component of Canadian fishery resources and comprise four major species. They are: witch flounder (*Glyptocephalus cynoglossus*), American plaice (*Hippoglossoides platessoides)*, Greenland halibut (*Reinhardtius hippoglossoides*), and yellowtail flounder (*Limanda ferruginea*). The fisheries for these species are made up of 11 separate management units, all under quota control with a total allowable catch in 1989 equalling 184 500 t for all stocks combined. Witch flounder is a relatively deep-water species, predominant at depths of 184 to 366 m and prefers temperatures in the range of 2.0 degree C to 6.0 degree C. It reaches its northern limits at Hamilton Bank, near southern Labrador, but is otherwise found throughout the southern range of the study area. American plaice is a more shallow-water species, preferring colder water. It is most abundant in depths of 90 to 250 m and bottom temperatures of -0.5 degree C to 2.5 degree C. While it is found throughout the whole study area, it is found in higher concentration on the tops of hard banks - particularly Hamilton Bank, the Grand Bank and St. Pierre Bank. The Greenland halibut is the deepest of the flatfishes, preferring depths of 500 to 1000 m and greater at temperatures of 0.0 degree C to 4.0 degree C. It is most abundant in areas north of the Grand Bank along the continental slope and deep channels running between the fishing banks. Yellowtail flounder, on the other hand, is the shallowest of the four species, preferring depths of 37 to 82 m where temperatures are in the range of 3.0 degree C to 5.0 degree C. The main area of significant abundance is on the southeastern Grand Bank known as the Southeast Shoal, although it is caught in a very small area of St. Pierre Bank. All species exhibit reductions in the age range of the respective populations since the beginning of commercial exploitation. As well, there have been increases in the growth rates and reductions in the age at maturity, with a few exceptions. These changes have generally been coincident with reduced population sizes although it was not possible to correlate analytically.

Bowering, W.R. and Brodie, W.B. 1999. Greenland halibut (*Reinhardtius hippoglossoides*). A review of the dynamics of its distribution and fisheries off eastern Canada and Greenland. *In* Ecology, fisheries and management of Greenland halibut (*Reinhardtius hippoglossoides* (Walbaum)) in the Canadian northwest Atlantic. *Edited by* W.R.Bowering. University of Bergen (Norway). Thesis (Ph.D.) University of Bergen, Bergen, Norway. p. 17

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[Thesis (Ph.D.) - University of Bergen, 1999]

Bowering, W.R. and Brodie, W.B. 2000. Calculation of catch-at-age for commercially caught Greenland halibut in NAFO Subarea 2 and Divisions 3KLMNO during 1975-99 with particular emphasis on construction of the catch-at-age matrix since 1989. NAFO SCR documents 00/24: 25 p.

Catch-at-age data from the commercial Greenland halibut (*Reinhardtius hippoglossoides*) fishery in NAFO Subarea 2 and Divisions 3KLMNO have been calculated annually since 1975. However, the data have been incomplete since 1989 due to uncertainty in the yearly catches in the NAFO Regulatory Area (NRA) and lack of ageing data. Catch-at-age data from the Canadian portion of the fishery have been available annually from 1975-97 and are updated here for 1998 and 1999. This paper describes how annual ageing data from the Canadian fishery were used in combination with annual length frequency data from other countries, primarily Spain and Portugal, fishing Greenland halibut in the NRA to compute catch-at-age from 1989-99. Where data were lacking from other countries their catches were generally adjusted by the combined catch-at-age of Spain and Portugal. Although total annual catches remain uncertain for many years, the computations were based on best estimates as agreed at the yearly June assessment meetings of the NAFO Scientific Council.

Bowering, W.R. and Chumakov, A.K. 1987. The distribution and relative abundance of Greenland halibut (*Reinhardtius hippoglossoides*) in the Canadian Northwest Atlantic. NAFO SCR documents 87/86: 32 p.

Bowering, W.R. and Chumakov, A.K. 1989. Distribution and relative abundance of Greenland halibut (*Reinhardtius hippoglossoides* (Walbaum)) in the Canadian Northwest Atlantic from Davis Strait to the northern Grand Bank. Fish. Res. 7: 301-327.

Catches had no apparent break in the continuity of distribution. They were most abundant along the slopes of the continental shelf and in the deep channels around the fishing banks. They were caught in depths 1000 m; preferred depth ranges varied with both latitude and season. For the areas where bottom temperature data were presented, fish were caught in a range of 0.0-6.0[deg]C with a preference for warmer water (5.1-6.0[deg]C) in N Labrador during summer compared with colder water (N. The commercial fishery which exists mostly in the more southerly area exploits a few younger age groups (6-9-yr-olds in particular) while older fish (>10 yr old) are hardly exploited.

Bowering, W.R. and Chumakov, A.K. 1990. Estimates of abundance and biomass of witch flounder (*Glyptocephalus cynoglossus*) in Div. 3NO and Greenland halibut (*Reinhardtius hippoglossoides*) in Div. 3KL from USSR groundfish surveys during 1987-89. NAFO SCR documents 90/57: 7 p.

The catches in the West Greenland shrimp fishery have been rather stable around 40-70.000 tons annually during the latest two decades. The amount of by-catch of fish in the shrimp fishery can not by estimated directly because the by-catch figures in the logbooks are considered unreliable. During the past there have been several attempts to estimate the by-catch from survey data and few direct observations from the commercial fishery made by staff from Greenland Institute of Natural Resources. These investigations indicate that the by catch of small Greenland halibut and small redfish sp. might be considerable. In the present paper the by-catch of a number of fish species in the commercial shrimp fishery in July-August is estimated from a stratified bottom conducted in the same period in NAFO Subarea. Due to an investigation of the variation in the catches of shrimp in the survey, the survey coverage was, in some areas, been better than previous years.

Bowering, W.R. and Lilly, G.R. 1985. Diet of Greenland halibut off southern Labrador and northeastern Newfoundland (Div. 2J+3K) in autumn of 1981-82, emphasizing predation on capelin. NAFO SCR documents 85/109 : 16 p.

Bowering, W.R. and Lilly, G.R. 1992. Greenland halibut (*Reinhardtius hippoglossoides*) off southern Labrador and northeastern Newfoundland (Northwest Atlantic) feed primarily on capelin (*Mallotus villosus*). Neth. J. Sea. Res. 29: 211-222.

Stomachs were collected from 10 300 Greenland halibut (*Reinhardtius hippoglossoides*) caught during the autumns of 1981, 1982 and 1984 on the continental shelf and upper slope off southern Labrador and northeastern Newfoundland (northwest Atlantic). Examination revealed strong similarity among years in the percentage of stomachs which were empty (42 to 48%), the average degree of stomach fullness, and the prey spectrum. Small (< 20 cm) Greenland halibut preyed mainly on small crustaceans and cephalopods, medium-sized (20 to 69 cm) individuals preyed primarily on capelin (*Mallotus villosus*), and large (> 69 cm) individuals preyed on a variety of demersal fish, particularly redfish (*Sebastes* sp.) and Greenland halibut. An abrupt change in diet at about 64 to 69 cm was related to changes in both feeding habit and geographic distribution. The quantity of capelin in the stomachs was greatest on Hamilton Bank and on or near the coastal shelf off southern Labrador and northeastern Newfoundland. Medium-sized Greenland halibut were not highly aggregated in those areas where they were most successful in finding capelin. Preliminary estimates of daily and annual prey consumption indicate that Greenland halibut is an important predator of capelin.

Bowering, W.R. and Lilly, G.R. 1999. Greenland halibut (*Reinhardtius hippoglossoides*) off southern Labrador and northeastern Newfoundland (northwest Atlantic) feed primarily on capelin (*Mallotus villosus*). *In* Ecology, fisheries and management of Greenland halibut (*Reinhardtius hippoglossoides* (Walbaum)) in the Canadian northwest Atlantic. *Edited by* W.R.Bowering. University of Bergen (Norway). Thesis (Ph.D.) University of Bergen, Bergen, Norway. p. 11

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Bowering, W.R. and Nedreaas, K.H. 2000. A comparison of Greenland halibut (*Reinhardtius hippoglossoides* (Walbaum)) fisheries and distribution in the Northwest and Northeast Atlantic. Sarsia 85: 61-76.

Greenland halibut (*Reinhardtius hippoglossoides* (Walbaum)) are widely distributed over extensive geographic areas of both the Northwest and Northeast Atlantic Ocean with no break in the continuity of the respective distributions. Although the entire Greenland halibut resource in the North Atlantic is genetically homogeneous they mainly comprise a single interbreeding stock in each of the two regional areas investigated. Both stocks show similar distribution patterns over depth. Generally, larger fish become more abundant and smaller fish less abundant in progressively deeper water with peak abundance occurring over a depth range of 400-1000 m. Greenland halibut in the Northwest Atlantic were observed to be most abundant in bottom temperatures mainly between 2 degree C and 6 degree C compared to 0 degree C to 4 degree C in the Northeast Atlantic. The fishery for Greenland halibut in the Northeast Atlantic was unregulated until 1992 although since 1995 catches substantially exceed those advised. The spawning stock size reached historically low levels during the 1990s and recruitment to the spawning stock remains uncertain based on the most recent assessment. In the Northwest Atlantic the Greenland halibut resource has been regulated by catch quota since 1974 although it was subjected to high-uncontrolled fishing pressure during the early 1990s. The spawning stock also reached historic low levels during this period but has recently showed improvement due to low fishing mortality since 1995 and better than average recruitment since 1990.

Bowering, W.R. and Nedreaas, K.H. 2001. Age validation and growth of Greenland halibut (*Reinhardtius hippoglossoides* (Walbaum)): A comparison of populations in the Northwest and Northeast Atlantic. Sarsia 86: 53-68.

Age validation exercises clearly established the expected modal size of 0-group Greenland halibut specific to the study area and time of sampling. Subsequently, the modal sizes of at least ages 1-3 (and sometimes 4) were determined and indicated that at these ages Greenland halibut will grow on average about 6-8 cm per year. It is emphasized, however, that validation work is specific for the years and areas in which the data are collected. Female Greenland halibut have a longer lifespan than males. It is shown that the difference between the maximum age of males and females differ by as much as 8 years in the Northwest Atlantic but the difference declined in recent years. In most instances for both the northwest and northeast Atlantic growth rates for females are slightly higher than for males after about age 5-6. For the northwest Atlantic data the apparent differences are greater in earlier years but show little difference since mid 1980s. Greenland halibut in the northeast Atlantic are generally larger at age up to about age 8 compared to those of the northwest Atlantic. By 1996, the overall patterns appear more similar. The results suggest that the growth patterns between the two regions may be converging to a similar pattern in recent years.

Bowering, W.R. and Orr, D.C. 2004. By-catch of Greenland halibut (*Reinhardtius hippoglossoides*, Wabaum) in the Canadian fishery for northern shrimp (*Pandalus borealis*, Koyer) in NAFO Subarea 2 and Divisions 3KL. NAFO SCR documents 04/67: 18 p.

The Canadian fishery for northern shrimp (*Pandalus borealis*) in NAFO Subarea 2 and 3KL has been increasing substantially in recent years and by 2003 has reached a catch of about 115 000 tons. Since young Greenland halibut *(Reinhardtius hippoglossoides*) and northern shrimp overlap in distribution, Greenland halibut is one of the most important species taken as bycatch in the northern shrimp fishery. The most recent assessment of Greenland halibut indicates that the resource has been declining over the last several years and is now at its lowest observed population size since 1975. Therefore, concerns have been raised regarding the potential effect on stock recovery from bycatch of Greenland halibut in the northern shrimp fishery. This paper estimates removals at age of Greenland halibut in the Canadian fishery for northern shrimp in NAFO Subarea 2 and Div. 3KL during 1996-2003. Results indicate that during this period less than 5% of an average year-class of Greenland halibut was taken as by-catch in the northern shrimp fishery. This suggests a potential loss in yield to the Greenland halibut fishery of about 900-1400 tons annually given recent fishing patterns.

Bowering, W.R. and Parsons, D.G. 1981. Observation on the relationships between shrimp (*Pandalus borealis*) and Greenland halibut (*Reinhardtius hippoglossoides*) in 2 Labrador channels. CAFSAC Res. Doc. 81/5: 23 p.

A pronounced increase in abundance of Greenland halibut has been observed in recent years in the Labrador shrimp channels. Biomass estimates and distribution of both species and food and feeding data for Greenland halibut in these areas were reviewed to provide a preliminary assessment of the relationship. Results indicated increases in abundance for Greenland halibut in 1980 of 2 to 4 times the 1979 level attributed mainly to immigration. It was also shown that increase may have a significant effect on shrimp mortality but the magnitude may not be evident until the research survey in 1981. During this survey the interaction should be studied in detail.

Bowering, W.R. and Parsons, D.G. 1986. Diel variability in trawl catches of Greenland halibut from the channels off coastal Labrador and implications for resource assessment. N. Am. J. Fish. Manage. 6: 149-155.

Catch data for Greenland halibut (*Reinhardtius hippoglossoides)* from trawl surveys conducted off the coast of Labrador were analyzed for diel trends. Numbers of fish caught during 4-h intervals from both repetitive fishing and resource surveys were higher and more variable during hours of daylight. There were concomitant changes in availability of fish of various sizes (ages) to the sampling gear. The demonstrated diel trends represent a potential for bias in the estimation of stock abundance, stock composition, and recruitment indices of Greenland halibut as derived from resource survey data.

Bowering, W.R. and Pitt, T.K. 1975. Yield per recruit assessment of Greenland halibut (Reinhardtius hippoglossoides), ICNAF Subarea 2 and Divisions 3K and 3L. ICNAF Res. Doc. 75/24: 7 p.

Bowering, W.R. and Power, D. 1993. An examination of spatial distribution of Greenland halibut in the Labrador-Eastern Newfoundland area of the Canadian Northwest Atlantic based on research surveys. NAFO SCR documents 93/62: 11 p.

The purpose of this paper is to examine more detailed spatial distribution of Greenland halibut in the Labrador and eastern Newfoundland area on an annual basis from available Canadian survey data collected during the 1978-92 period.

Bowering, W.R. and Power, D. 1995. Distribution and abundance of Greenland halibut at the continental slope of Divisions 3KLMN based upon Canadian deepwater surveys in 1991, 1994, and 1995. NAFO SCR documents 95/52: 11 p.

Since about 1989, a deepwater fishery for Greenland halibut has developed at the continental slope of the NAFO Regulatory Area in Div. 3LM and more recently in Div. 3N in depths generally exceeding 1000 meters. Catches in this area have been in the range of 50,000-60,000 tons since 1990. The fishery has been carried out mainly by freezer trawlers from EU (Spain) and EU (Portugal) as well as other non-contracting parties. In addition, a small vessel gillnet fishery has also developed in the Canadian zone at the continental slope primarily of Div. 3KL but more recently in Div. 2GH. The catches from the fishery component, however, has been relatively low by comparison to the non-Canadian trawler fishery with catches usually around 3,000 tons or less in the last couple of years. In order to evaluate the distribution and abundance of Greenland halibut, in particular, deepwater trawl surveys were conducted in 1991, 1994 and 1995 in Div. 3KLM in 1 991 and included some of Div. 3N in 1994 and 1995. This paper describes the distribution and abundance of Greenland halibut as well as a comparative analysis of the size and age compositions among the three years and divisions surveyed.

Bowering, W.R. and Power, D. 1995. Spatial distribution of Greenland halibut (*Reinhardtius hippoglossoides* (Walbaum)) in the Labrador-eastern Newfoundland area of the Canadian Northwest Atlantic. Northwest Atl. Fish. Organ. Sci. Counc. Stud. 22: 51-61.

Results indicated that for Div. 2GH there was no apparent change in the spatial distribution of Greenland halibut between the late-1970s and late-1980s even though overall abundance of fish was significantly lower in the late-1980s compared to the late-1970s. For Div. 2J and 3K the spatial distribution pattern was about the same between the late-1970s and late-1980s at which time Greenland halibut rapidly disappeared from Div. 2J, followed by Div. 3K within a couple of years. It is concluded that this was a result of a significant migration southward of Greenland halibut to the deep waters of Flemish Pass in Div. 3LM.

Bowering, W.R. and Stansbury, D.E. 1983. Regression of weight on length of Greenland halibut (*Reinhardtius hippoglossoides*) in the Canadian Northwest Atlantic. NAFO SCR documents 83/6/18: 14 p.

Recent TAC's of Greenland halibut in the Northwest Atlantic have reached a combined value of 100,000 MT. In order to perform proper analytical assessments for Greenland halibut as with most species the relationship between length and weight is a very necessary and important parameter. Because of the importance of the Greenland halibut fishery and its assessment this parameter has now been derived for most areas under management regimes and presented in this document.

Bowering, W.R. and Stansbury, D.E. 1984. Regressions of weight on length for Greenland halibut, *Reinhardtius hippoglossoides*, from Canadian waters of the Northwest Atlantic. J. Northwest Atl. Fish. Sci. 5: 107-108.

This paper presents the length-weight relationships for the Greenland halibut (*Reinhardtius hippoglossoides*), from Canadian waters of the Northwest Atlantic. The relationship between length and weight is a necessary parameter in performing proper analytical assessments of fish stocks.

Bowering, W.R., Lilly, G.R., and Parsons, D.G. 1982. Predators of shrimp (*Pandalus borealis*) in the Cartwright (Div. 2J) and Hopedale (Div. 2H) Channels. CAFSAC Res. Doc. 82/9: 32 p.

The abundance and prey composition of Greenland halibut and cod on shrimp grounds in Cartwright and Hopedale Channels were determined in July 1981. Greenland halibut, which had increased dramatically in biomass in 1980, returned in 1981 to near pre-1980 levels. These changes are attributed primarily to immigration before the 1980 fishing season and emigration before the 1981 season. The surge of Greenland halibut into the Channels may have resulted in increased mortality of shrimp, but such natural mortality cannot be quantified or even demonstrated with present data. Cod fed predominantly on shrimp, and were found to be significant predators, even though their biomass was low compared with that of Greenland halibut, especially in Hopedale Channel.

Bowering, W.R., Parsons, D.G., and Lilly, G.R. 1983. Predation on shrimp (*Pandalus borealis)* by Greenland halibut (*Reinhardtius hippoglossoides*) and Atlantic cod (*Gadus morhua*) off coastal Labrador (Div. 2H and 2J). NAFO SCR documents 83/88: 26 p.

Bowering, W.R., Parsons, D.G., and Lilly, G.R. 1984. Predation on shrimp (*Pandalus borealis)* by Greenland halibut (*Reinhardtius hippoglossoides)* and Atlantic cod (*Gadus morhua*) off Labrador. ICES CM 1984/G:54: 30 p.

Bowering, W.R., Brodie, W.B., and Power, D. 1993. An evaluation of the status of the Greenland halibut resource in NAFO Subarea 2 and Divisions 3KLM. NAFO SCR documents 93/75: 29 p.

The authors present fishery statistics on the status of Greenland halibut (*Reinhardtius hippoglossoides*) in NAFO Subarea 2 and Divisions 3KLM.

Bowering, W.R., Brodie, W.B., Power, D., and Morgan, M.J. 1994. Greenland halibut in NAFO Subarea 2 and Divisions 3KLM: a rapidly declining resource with a rapidly increasing fishery. NAFO SCR documents 94/57: 25 p.

The authors state that unless serious consideration is given to controlling unregulated catches of Greenland halibut (*Reinhardtius hippoglossoides)* in NAFO Subarea 2 and Divisions 3KLM, this stock will decline further and seriously compromise the growth potential of incoming year-classes.

Bowering, W.R., Brodie, W.B., Power, D., and Morgan, M.J. 1995. An assessment of the Greenland halibut resource in NAFO Subarea 2 and Divisions 3KLMN. NAFO SCR documents 95/64: 20 p.

Canadian catches of Greenland halibut (*Reinhardtius hippoglossoides*) have been taken mostly by gillnet with a significant proportion taken by otter trawlers. With the exception of 1987, catches have been declining steadily inside the Canadian zone since the early 1980's from a high of 30,000 tons to less than 3,000 tons by 1994. This declining trend was a result of reduced catch rates, low prices and multi-licensed vessels fishing other species that offered a better return on costs.

Bowering, W.R., Power, D., and Morgan, M.J. 1995. Distribution and abundance of five major groundfish species at the continental slope of Divisions 3KLMN based upon Canadian deepwater surveys in 1991, 1994 and 1995. NAFO SCR documents 95/51: 26 p.

Since about 1989, a deepwater fishery for Greenland halibut *Reinhardtius hippoglossoides* has developed at the continental slope of the NAFO Regulatory Area in Div. 3LM and more recently in Div. 3N in depths generally exceeding 1000 meters. In order to evaluate the distribution and abundance of Greenland halibut, in particular, deepwater trawl surveys were conducted in 1991, in Div. 3KLM and in Div. 3KLM and part of Div. 3N in 1994 and 1995. This paper describes the distribution and abundance of five other groundfish species caught during these surveys in addition to Greenland halibut. The five species are American plaice *(Hippoglossoides platessoides*) (*Glyptocephalus cynoglossus)*, redfish (*Sebastes* spp.) witch flounder (*Macrourus berglax*) redfish, roundnose grenadier (*Coryphaenoides rupestris*) and roughhead grenadier (*Macrourus berglax*).

Bowering, W.R., Brodie, W.B., Morgan, M.J., Power, D., and Orr, D. 1996. The status of the Greenland halibut resource in the management area of NAFO Subarea 2 and Divisions 3KLMNO. NAFO SCR documents 96/73: 34 p.

Bowering, W.R., Brodie, W.B., Morgan, M.J., Power, D., and Rivard, D. 2000. An assessment of Greenland halibut in NAFO Subarea 2 and Divisions 3KLMNO. NAFO SCR documents 00/43: 33 p.

The fishery for Greenland halibut (*Reinhardtius hippoglosoides)* in this management area began in the early 1960's, using synthetic gillnets in the deepwater bays of eastern Newfoundland, particularly Trinity Bay. As catches declined here, the effort moved progressively northward in the other bays along the east and northeast coast of Newfoundland. Catches increased from fairly low levels in the early 1960s to over 36,000 tons by 1969 and ranged from 24,000 tons to 39,000 tons over the next 15 years. With the exception of 1987, catches in the late 1980s were around 18,000 to 20,000 tons. In 1990, an intense fishery for Greenland halibut developed in the NAFO Regulatory Area (NRA) of Div 3L and 3M, in the deepwater areas known as Sackville Spur and Flemish Pass. The development of this fishery resulted in a rapid escalation of catches to between 47,000 - 65,000 tons during the early 1990's. After 1994 catches declined to between 15,000 - 24,000 tons due to regulation of the fishery from 1995-1999. A virtual population analysis was conducted using various ADAPT formulations. Results from the assessment and mortality estimates from survey data both indicated that fishing mortality was high during the early 1990's with the escalation in catches up to 1994 but declined to relatively low levels since then. Year-classes of the early 1990s appear to be above average especially 1993-1995. While the direction of the change in recruitment and population abundance was obvious from these analyses, results may be affected by factors that cannot be taken into account in traditional analyses such as the ones presented here. In particular, there is concern with the possible effect of the conversion of the Canadian survey indices from Engel trawl estimates to Campelen trawl equivalents for very young ages and with the apparent change in survey catchability over time. Also, as the data available could be equally well explained with very different values for population dynamic parameters such as natural mortality, it is not possible to estimate without ambiguity the actual population mechanism at play.

Brattey, J. and Davidson, W.S. 1996. Genetic variation within *Pseudoterranova decipiens* (Nematoda: Ascaridoidea) from Canadian Atlantic marine fishes and seals: characterization by RFLP analysis of genomic DNA. Can. J. Fish. Aquat. Sci. 53: 333-341.

Genetic variation in the ribosomal RNA gene complex (rDNA) of 181 individual

Pseudoterranova decipiens from 3 seal species (*Erignathus barbatus, Halichoerus grypus* and *Phoca vitulina*) and 6 marine fishes (*Gadus morhua, Hemitripterus americanus, Myoxocephalus scorpius, Hippoglossus hippoglossus, Hippglossoides platessoides* and *Reinhardtius hippoglossoides*) from the Atlantic coast of Canada was investigated by restriction endonuclease digestion followed by Southern blotting using a heterologous cloned rDNA repeating unit as a probe. Five enzymes (EcoRI, HaeII, HpaI, PstI and PvuII) yielded informative restriction fragment length polymorphisms and the results, which corroborated previous studies of allozyme variation, indicated the presence of 2 species with no evidence of hybridization or introgression between them: Pseudoterranova decipiens C infects E. barbatus and is characterized by 6 unique restriction fragments; P. decipiens B infects both Phoca vitulina and H. grypus, and is characterized by 10 unique restriction fragments. Larvae from most areas showed restriction fragment length polymorphisms characteristic of P. decipiens B but some specimens collected from flatfishes off Labrador were P. decipiens C. Restriction fragment patterns also revealed polymorphism, both within and between species, and among ribosomal repeat units within individuals, particularly within *P. decipiens* B. The genetic polymorphisms observed in *P. decipiens* from *H. grypus* and *Phoca vitulina* were similar, suggesting interbreeding among nematodes from these two seal species.

Brethes, J.-C., Ochman, S., and Tremblay, H. 1986. Prévisions sur l'évolution des stocks halieutiques accessibles aux pêcheurs québécois. Université du Québec à Rimouski. Groupe d'étude des ressources maritimes. Rimouski, Québec. 153 p.
[In French]

Brochu, C., Moore, S., and Pelletier, É. 1995. Polychlorinated dibenzo-p-dioxins and dibenzofurans in sediments and biota of the Saguenay Fjord and the St. Lawrence Estuary. Mar. Pollut. Bull. 30: 515-523.

Sediment samples and marine organisms were collected in the Saguenay Fjord and at two selected sites in the St Lawrence Estuary in 1991. Total PCDDs and total PCDFs ranged from 22 to 352 and 29 to 188 ng kg super(-1), respectively in Saguenay sediments, while total PCDFs reached 287 ng kg super(-1) in Baie des Anglais, a small and deep bay of the St Lawrence Estuary impacted by PCBs during the 1970s. All biological samples contained detectable amounts of chlorinated dibenzodioxins and dibenzofurans, apart from the North Atlantic cod (*Gadus morhua*). The highest concentrations (up to 59.7 ng kg super(-1) total PCDFs and 2.54 ng kg super(-1) 2,3,7,8-T sub(4)CDD Equivalent (TCDD TEQ)) were observed in crab (*Chionoecetes opilio*) caught in Saguenay, and in crab and whelk (*Buccinum undatum*) collected in Baie des Anglais. Nordic shrimp (*Pandalus borealis*) seems less contaminated with a maximum total PCDDs and PCDFs concentration of 14.0 ng kg super(-1) and TCDD TEQ never exceeding 0.7 ng kg super(-1). Greenland halibut (*Reinhardtius hippoglossoides*) caught in the Saguenay Fjord contained only 2,3,7,8 substituted congeners in their tissues leading to a very low average TCDD TEQ of 1.66 ng kg super(-1). Based upon this first series of results, benthic organisms and fish from the Saguenay Fjord and the north shore of the St Lawrence Estuary are exposed to low levels of PCDDs and PCDFs, and carry tissue concentrations well below international guidelines for fisheries products.

Brodie, W. 1999. Analysis of data from the commercial fishery for Greenland halibut in Subarea 0. NAFO SCR documents 99/47: 10 p.

Data on Greenland halibut from the comercial fishery in Subarea 0 were analyzed. Catch at age showed a slight shift to younger fish after 1993, with a peak at age 7 in each year. There were no major trends in weight at age during the 1990's. There was little range in the standardized catch rate from 1990 to 1998, although CPUE in 1995 was slightly higher than in 1996-1998. Standardized effort was lower in the 1994-98 period than in the earlier 4 years, due mainly to the reduced quota available for the fleets in the latter period.

Due to the frequency of fleet changes in this fishery, the index of CPUE may not be a reliable indicator of stock abundance in this area.

Brodie, W. and Bowering, W.R. 1998. Data from the commercial fishery for Greenland halibut in Subarea 0. NAFO SCR documents 98/39 : 11 p.

Data on Greenland halibut (*Reinhardtius hippoglossoides*) from the commercial fishery in Subarea 0 were analyzed. Catch at age showed a slight shift to younger fish in recent years, with a peak at age 7. There were no trends in weight at age during the 1990s. There was little range in the standardized catch rate from 1990 to 1997, although CPUE in 1995 and 1997 was slightly higher than previous years. Standardized effort was lower in the 1994-97 period than in the earlier 4 years, due mainly to the reduced quota available for the fleets in the latter period.

Brodie, W.B. 1991. An assessment of Greenland halibut in SA2 + Divisions 3KL. NAFO SCR documents 91/88: 29 p.

Brodie, W.B. 1999. Analysis of data from the commercial fishery for Greenland halibut in Subarea 0. NAFO SCR documents 99/47: 10 p.

Data on Greenland halibut from the commercial fishery in Subarea 0 were analyzed. Catch at age showed a slight shift to younger fish after 1993, with a peak at age 7 in each year. There were no major trends in weight at age during the 1990's. There was little range in the standardized catch rate from 1990 to 1998, although CPUE in 1995 was slightly higher than in 1996-1998. Standardized effort was lower in the 1994-98 period than in the earlier 4 years, due mainly to the reduced quota available for the fleets in the latter period. Due to the frequency of fleet changes in this fishery, the index of APUE may not be a reliable indicator of stock abundance in this area.

Brodie, W.B. 2000. Data from the commercial fishery for Greenland halibut in Subarea 0. NAFO SCR documents 00/26: 7 p.

This document updates information from the commercial fishery for Greenland halibut (*Reinhardtius hippoglossoides*) in Subarea 0. Catch at age showed a slight shift to younger fish after 1993, with a peak at age 7 in each year since then. There were no major trends in weight at age during the 1990s. Due to the frequency of fleet changes in this fishery, and the lack of continuity among vessels within fleets, a standardized index of CPUE is not considered to be a reliable indicator of overall stock abundance in this area. Unstandardized CPUE from the Canadian fishery showed a slight increase from 1998 to 1999, but has been relatively stable since 1996.

Brodie, W.B. and Baird, J.W. 1992. Data for assessment of Greenland halibut in SA2 + Divisions 3KLM. NAFO SCR documents 92/81: 16 p.

Brodie, W.B. and Power, D. 2001. Canadian fishery for Greenland halibut in SA2 + Div. 3KLMNO, with emphasis on 2000. NAFO SCR documents 01/65: 13 p.

The Canadian catch of Greenland halibut (*Reinhardtius hippoglossoides*) in 2000 in NAFO Subarea 2 and Divisions 3KLMNO was reported to be almost 10,600 tons, more than two and one half times the catches in 1998 and 1999. Effort was higher for the three major gear types in the fishery. Gillnet was the predominant gear type, although otter trawl catches of about 1300 tons were the highest by this gear type since 1992. Much of the catch came from Divisions 3KL, in depths less than 550 metres. Over half of the catch was taken in July and August. The catch at age in all areas and gear sectors in 2000 was dominated by the 1993 year-class.

Brodie, W.B. and Power, D. 2001. Data from the offshore Canadian commercial fishery for Greenland halibut in Subarea 0. NAFO SCR documents 01/43: 8 p.

This document updates information from the commercial fishery for Greenland halibut (*Reinhardtius hipploglossoides*) in Subarea 0, with a focus on the Canadian commercial fishery in 2000. Catch at age showed a slight shift to younger fish after 1993, with a peak at age 7 in each year since then. As in previous years, catch at age from 2000 indicates larger fish in the fixed gear catches compared to the mobile gears. There were no major trends in weight at age during the period 1990 to 2000. Due to the frequency of fleet changes in this fishery, and the lack of continuity among vessels within fleets, a standardized index of CPUE for Subarea 0 alone is not considered to be a reliable indicator of overall stock abundance. Unstandardized CPUE from the Canadian fishery showed a slight increase from 1998 to 1999, but has been relatively stable since 1996. CPUE data for 2000 are incomplete and indicate the presence of twin trawls in the Greenland halibut fishery, possibly for the first time.

Brodie, W.B. and Power, D. 2002. The Canadian fishery for Greenland halibut in Subarea 2 + Divisions 3KLMNO, with emphasis on 2001. NAFO SCR documents 02/39: 12 p.

The Canadian catch of Greenland halibut (*Reinhardtius hippoglossoides*) in 2001 in NAFO Subarea 2 and Divisions 3KLMNO was reported to be almost 8,400 tons. This was down by 2,200 tons from the catch in 2000, but was still more than double the catches taken in each of 1998 and 1999. Lower catches in the gillnet sector, primarily in Div. 3K, were responsible for the decline. Although gillnet was still the predominant gear type, otter trawl catches of about 1800 tons were 500 tons higher than in 2000, and the highest by this fleet sector in ten years. As in 2000, much of the catch came from Divisions 3KL, and about half of the catch was taken in July and August. The catch at age in 2001 was dominated by the 1994 year class, which accounted for 55% of the catch numbers and 40% of the catch weight.

Brodie, W.B. and Power, D. 2002. Update of data from the offshore Canadian commercial fishery for Greenland halibut in Division 0B. NAFO SCR documents 02/50: 7 p.

This document updates information from the commercial fishery for Greenland halibut in Subarea 0, with a focus on the Canadian commercial fishery in 2001. Catch at age showed a slight shift to younger fish after 1993, with a peak at age 7 in each year since then. As in previous years, catch at age from 2001 indicates larger fish in the fixed gear catches compared to the mobile gears. There were no major trends in weight at age during the period 1990 to 2001. Due to the frequency of fleet changes in this fishery, and the lack of continuity among vessels within fleets, a standardized index of CPUE for Subarea 0 alone is not considered to be a reliable indicator of overall stock abundance. Unstandardized CPUE from the Canadian fishery showed a slight increase from 1998 to 1999, but has been relatively stable since 1996. CPUE data for 2000 and 2001 are imcomplete and not updated here. Twin trawls were present in the Greenland halibut fishery in Div. 0B in 2000 and 2001 but complete data were not available from this fleet component.

Brodie, W.B. and Power, D. 2003. The Canadian fishery for Greenland halibut in SA 2 + Divisions 3KLMNO, with emphasis on 2002. NAFO SCR documents 03/36: 14 p.

The Canadian catch of Greenland halibut (*Reinhardtius hippoglossoides)* in 2002 in NAFO Subarea 2 and Divisions 3KLMNO was reported to be almost 6 300 tons. This was down by 2 100 tons from the catch in 2001, and about 4 300 tons lower than the catch in 2000. Reduced catches in the gillnet sector, primarily in Div. 3KL, were responsible for the decline, although gillnet was still the predominant gear type. The otter trawl catch of just under 1 800 tons was similar to the 2001 level, which was the highest by this fleet sector in ten years. As in 2000 and 2001, much of the catch came from Div. 3KL, and over half of the catch was taken in June and July. The catch at age in 2002 was dominated by the 195 year-class, which accounted for 42% of the catch numbers and 29% of the catch weight.

Brodie, W.B. and Power, D. 2004. The Canadian fishery for Greenland halibut in Subarea 2 + 3KLMNO, with emphasis on 2003. NAFO SCR documents 04/33: 15 p.

The Canadian catch of Greenland halibut (*Reinhardtius hippoglossoides*) in 2003 in NAFO Subarea 2 and Divisions 3 KLMNO was reported to be almost 7 000 tons, up about 10% from 2002. There was an increase in otter trawl catches, primarily in Div. 2H, to the highest level since 1985. There were reduced catches in the gillnet sector, mainly in Div. 3L. As in 2000-2002, much of the catch in 2003 came from Div. 3K, and over 80% of the catch was taken from June to August. The catch at age in 2003 was dominated by the 1996 year class, which accounted for 43% of the catch numbers and 33% of the catch weight in the Canadian fishery.

Brodie, W.B. and Power, D. 2005. The Canadian fishery for Greenland halibut in Subarea 2 + Divisions 3KLMNO, with emphasis on 2004. NAFO SCR documents 05/62: 16 p.

The Canadian catch of Greenland halibut in 2004 in NAFO Subarea 2 and Divisions 3KLMNO was reported to be about 4 900 tons, a decrease of 2 100 tons from 2003. There was a decrease in otter trawl catches, primarily in Div. 2H, from the high level in 2003. Catches in the gillnet sector were similar in 2003 and 2004, although there was more deepwater catch in 2004. As in previous years, much of the catch in 2004 came from Div. 3K, and almost 75% of the catch was taken in June to August. The catch at age in 2004 was dominated by the 1997-98 year-classes, which accounted for 60% of the catch numbers and 47% of the catch weight in the Canadian fishery. Mean weights at age in 2004 were similar to previous years. After a gradual increase from 1992 to 2001, CPUE from Canadian otter trawlers has declined since then.

Brodie, W.B., Chumakov, A.K., and Bowering, W.R. 1991. Update of abundance and biomass estimates of witch flounder in Divisions 3NO and Greenland halibut in Divisions 3KL from USSR surveys in 1987-90. NAFO SCR documents 91/56: 7 p.

Bowering and Chumakov (1990) presented the results of USSR surveys in 1987-89 for Greenland halibut in Div. 3KL and witch flounder in Div. 3NO. The purpose was to document some survey data for these species in deep water areas where Canadian spring surveys generally have not covered, e.g., greater than 366m in Div. 3L for G. halibut and greater than 366m in Div. 3NO for witch flounder. This paper adds the information from the 1990 USSR survey and examines the trends since 1987.

Brodie, W.B., Baird, J.W., and Power, D. 1992. Analysis of data from deepwater surveys in Div. 0B, 2GHJ, and 3KLM in 1991. NAFO SCR documents 92/82: 8 p.

With the development of fisheries in the deep water in the NAFO Regulatory Area in Div. 3LM, it was decided to carry out research vessel surveys in this area to learn more about the distribution and abundance of several species, particularly Greenland halibut and grenadiers. As well as surveys in this area, Canada also conducted a research survey on the slope edge extending from Davis Strait to southern Labrador. This paper presents the results of this work.

Brodie, W.B., Bowering, W.R., Power, D., and Orr, D. 1997. An assessment of Greenland halibut in NAFO Subarea 2 and Divisions 3KLMNO. NAFO SCR documents 97/52: 37 p.

The fishery for Greenland halibut, *Reinhardtius hippoglossoides*, in this management area began in the early 1960s, using synthetic gillnets in the deepwater bays of eastern Newfoundland, particularly Trinity Bay. As catches declined there, the effort moved northward. Subsequently vessels moved offshore to the deep channels. Catches increased from fairly low levels in the early 1960s to over 36,000 tons by 1969 and ranged from 24,000 tons to 39,000 tons over the next 15 years. As a result of new management measures introduced by the NAFO Fisheries Commission in 1995 i.e. extensive quota restrictions and 100% observer coverage in the NRA, catches were greatly reduced. Catches from the stock in 1995-96 represent a reduction of about 70% compared to the average annual catch of the previous 5 years. The fishable biomass in this stock is still at a relatively low level. Most indices of abundance showed some improvement in 1996, due mainly to the recruitment of above-average year-classes. Given the reduction in catches in 1995-96, combined with improved recruitment estimates, this stock should show signs of recovery over the next few years.

Brodie, W.B., Bowering, W.R., and Orr, D. 1997. Comparison of results for Greenland halibut from Canadian and Japanese research vessel surveys in Divisions 2GH in 1996. NAFO SCR documents 97/30: 16 p.

During 1996, trawl surveys of NAFO Divs.2GH were conducted independently by Japan and Canada. The survey by Japan was their first in this area, while Canada has conducted several surveys in Divs.2GH since 1977, the most recent before 1996 being in 1991. This paper examines the results of these surveys as they pertain to Greenland halibut, *Reinhardtius hippoglossoides.* A total of 134 sets were analyzed from the Japanese survey, compared to 117 in the Canadian survey. Comparison of catches from three strata fished in the surveys of 1978-81 with the same data for 1987-91 indicates a decline in Greenland halibut abundance and biomass over this period. Even though the catchability of the trawls used in 1996 is not relative to all the trawls used in these previous survey series, it appears that the biomass of Greenland halibut in Divs.2GH is at a lower level than that observed in the late 1970s and early 1980s.

Brodie, W.B., Bowering, W.R., Power, D., and Orr, D. 1998. An assessment of Greenland halibut in NAFO Subarea 2 and Divisions 3KLMNO. NAFO SCR documents 98/47: 38 p.

The fishery for Greenland halibut (*Reinhardtius hippoglossoides)* in this management area began in the early 1960s, using synthetic gillnets in the deepwater bays of eastern Newfoundland, particularly Trinity Bay. As catches declined here, the effort moved progressively northward in the other bays along the east and northeast coast of Newfoundland. Subsequently, vessels moved further offshore to the deep channels running between the shallow fishing banks. Catches increased from fairly low levels in the early 1960s to over 36,000 tons by 1969 and ranged from 24,000 to 39,000 tons over the next 15 years. With the exception of 1987, catches in the late 1980s were around 18,000 to 20,000 tons. In 1990, an intense fishery for Greenland halibut developed in the NAFO Regulatory Area of Div. 3L and 3M. The development of this fishery resulted in a rapid escalation of catches to about 47,000 tons in 1990. Catches in 1991 to 1993 were estimated to be around 55,000 tons although some estimates were nearer 75,000 tons. Best estimates of catch suggested a decline to about 51,000 tons in 1994. As a result of management measures introduced by the NAFO Fisheries Commission in 1995, catches were greatly reduced. In 1995, catch was estimated to be about 15,000 tons, increasing to 16,000 tons in 1996, and to about 20,000 tons in 1997. The fishable biomass in this stock is at a relatively low level, but appears to be increasing as a result of improved recruitment. Most indices of abundance showed some improvement in 1996 and 1997. Given the reduction in catches in 1996 and 1997 combined with higher recruitment estimates, this stock should continue to show signs of recovery over the next few years. A catch of 30,000 tons in 1999 should not be detrimental to the continued recovery of the stock.

Brodie, W.B., Bowering, W.R., Power, D., Morgan, M.J., and Boland, G. 1999. An assessment of Greenland halibut in NAFO Subarea 2 and Divisions 3KLMNO. NAFO SCR documents 99/38: 41 p.

Assessment of the Greenland halibut stock in Subarea 2 + Divisions 3KLMNO was based primarily on the interpretation of research vessel and CPUE indices. No VPA was possible due to the lack of catch-at-age data for all years. The biomass of fish greater than 35 cm was below average in 1998, but still appears to be increasing slowly. The number of older, mature fish in the surveys remains low, and SSB estimates are still uncertain. Surveys in 1997 confirmed the abundance of year-classes previously thought to be strong, although in 1998, the 1995 year-class did not apear to be as strong as previously thought, based on the Canadian surveys. The 1996 and 1997 year-classes do not appear to be as large as those of 1993-1995. There was a significant reduction in catches from a range of 50 000 to 70 000 tons in the early 1990s, to between 15 000 and 20 000 tons in 1995-1998. The biomass of fish greater than 35 cm continues to increase, although at a slow rate, and is still relatively low, but should continue to increase in 1999-2000 if current levels of exploitation are maintained. The success of most fisheries in 1999-2000 will depend mainly on the 1992 and 1993 year-classes, based on typical age compositions observed in the past. The 1994 and 1995 year-classes should not have a major effect on most fisheries until 2001. The NAFO Scientific Council was unable to advise on a specific TAC for this stock for 2000. However, given the present level of fishable biomass, SC recommended that a catch in 2000 of about 30 000 tons is likely to allow the stock to continue to increase.

Brothers, G. 1976. Commercial explorations for shrimp and turbot, Labrador. Canada. Fisheries and Marine Service (Newfoundland Region). Industrial Development Branch, Newfoundland. 36 p.

The purpose of this fishery survey was to determine the commercial distribution of shell fish and groundfish in areas off northern Newfoundland and southern Labrador where earlier research surveys had provided information pertaining to various groundfish and shellfish stocks. This is especially true for the Hawke Channel, an area off southern Labrador where shrimp and crab among other species were known to exist. Other areas explored were Ironbound Bank, Tooker Bank, Ritu Bank and Funk Island Deep. These fishing grounds were believed to support commercial stocks of turbot and other groundfish. Summary: Results of exploratory fishing indicate that potential shrimp, turbot, and crab fisheries exist in the Hawke Channel area at depths ranging from 200-240 fathoms. At depths below 175 fathoms, very low catches were yielded and rough bottom conditions prevented much of the Hawke Channel from being successfully fished.

Brothers, G. 2002. Greenland halibut (turbot) selectivity experiments carried out aboard the Arctic Endurance. Project summary (Fisheries Diversification Program (Canada).Environmental Awareness & Conservation Technology Component) EACT-5.2002: 32 p.

During the at-sea trials, three objectives were to be achieved. Trials were conducted to: 1. measure the selectivity of a Vonin "454" mesh trawl modified with 100 mm mesh in the fore part (720x100) and rigged with a 145 mm diamond mesh cod-end (experimental trawl A); 2. measure the selectivity of a Vonin 454 mesh trawl modified with 100 mm mesh in the fore part (720x100) and rigged with 155 square mesh cod-end (experimental trawl B); and 3. compare the relative performance of both gears in terms of small fish retention.

Brothers, G. 2002. Reducing snow crab by-catch in turbot gillnets. Project summary (Fisheries Diversification Program (Canada).Environmental Awareness & Conservation Technology Component) EACT-10.2002: 3 p.

To assess the effectiveness of a modified gillnet in reducing the by-catch of snow crab in the gillnet turbot fishery, by means of a test fishery using both standard and modified gillnets.

Brothers, G. and Duthie, A. 2001. Greenland halibut (turbot) experiments carried out aboard commercial vessels. Project summary (Fisheries Diversification Program (Canada).Environmental Awareness & Conservation Technology Component) EACT-7.2001: 11 p.

This summary provides an overview of the activities that have been undertaken by members of the Turbot Industry Working Group to address small fish retention in turbot trawls.

Brothers, G. and Scott, W.B. 1974. Fishery development: northern Labrador. Canada. Fisheries and Marine Service (Newfoundland Region). Industrial Development Branch, St. John's, NF. 42 p.

The purpose of this program was to assess the possibilities of further developing the inshore fishery in Northern Labrador, with a view to extending the fishing season and assisting local fishermen in becoming more diversified in their operation. Summary: During the project, it was realized that there was an apparent potential to support a commercial scallop and turbot fishery. Limited flounder catches, discouraged any attempt to develop a flounder fishery. The bottom trawling technique tested, proved unsuccessful and uneconomical, due to the rough bottom. However, the gillnet proved very effective in catching cod and turbot.

Brown, K. 1977. Shift to the north : a report on the Atlantic Groundfish Vessel Dislocation Adjustment Program in the Maritime Provinces 1976. Can.Fish.Mar.Serv.Misc.Spec.Publ. 35: 23 p.

In response to Canada's decision to extend its fisheries jurisdiction to 200 miles in January 1977 and the marked decline in catches on traditional fishing grounds, 20 exploratory voyages totalling 304 sea days, (283 in waters north of 55 degrees 20 N) were financially assisted by the Maritimes Region of Fisheries and Marine Service, Department of Fisheries and the Environment. Major catches in the more northern regions were redfish, turbot, and grenadier caught mainly by an Engels bottom trawl at 250-300 fathoms. Stocks of grenadiers were considered to be sufficient to support a commercial fishery but unavoidable large by-catches of redfish were a major concern.

Buch, B. 1996. Denmark (Greenland) request for scientific advice on management of certain stocks in 1997. NAFO SCS documents 96/1: 2 p.

Buch, E., Nielsen, M.H., and Pedersen, S.A. 2002. Ecosystem variability and regime shift in West Greenland waters. NAFO SCR documents 02/16: 19 p.

A review of the past 50 years climate conditions off West Greenland is given. Large variability in the atmospheric, oceanographic and sea-ice conditions as well as in the fish stocks is found. A positive relationship is found between the hydrographic conditions expressed by the water temperature and the fish recruitment of cod (*Gadus morhua*) and redfish (*Sebastes mentella*) whereas the recruitment of shrimps (*Pandalus borealis*) and halibuts (*Reinhardtius hippoglossoides*) seems to react positively to lower temperatures. Observed shifts in the hydrographic conditions during the second half of the 1990s indicate, that a change in the fish stock environment may be expected in the coming years. Relationships between the past variations in fisheries resources, hydrographic conditions, and the large-scale environment may be expected in the coming years. Relationships between the past variations in fisheries resources, hydrographic conditions, and the large-scale climate conditions, expressed by the North Atlantic Oscillation (NAO), are analyzed and tested for links.

Bulatov, O.A. 1983. Distribution of eggs and larvae of the Greenland halibut *Reinhardtius hippoglossoides* (Pleuronectidae), in the eastern Bering Sea. J. Ichthyol. 23: 157-159.

Data are presented regarding eggs and larvae of *R. hippoglossoides* in the eastern Bering Sea. The egg size is very close to that of halibut from the Atlantic Ocean. In late February-early March, the embryos are at development stage IV. Spatial-temporal distribution of the eggs indicates that spawning takes place along the continental slope during winter.

Bulatov, O.A. 1983. Raspredelenie ikry i lichinok chernogo paltusa *Reinhardtius hippoglossoides* (Walbaum) (Pleuronectidae) v vostochnoj chasti Beringova morya [Distribution of eggs and larvae of the Greenland halibut *Reinhardtius hippoglossoides* (Walbaum) in the eastern Bering Sea]. Vopr. Ikhtiol. 23: 162-164.
[In Russian]

The average size of halibut (*R. hippoglossoides*) eggs in the Bering Sea is 3.84 mm. In late February-early March the embryos are at stage 4. The eggs occur in vertical hauls only over depths of 200-3000 m beyond the shelf zone. The first larvae averaging 17.9 mm occur in ichthyoplankton samples in May, their size increasing to 33.1 mm in June. The larvae measuring 27 mm and more perform vertical migrations to surface layers. The spatial-seasonal distribution of eggs suggests that the spawning takes place over the continental slope in winter. The main spawning area is off Unimak I. The eggs and larvae are carried by currents to the shelf zone.

Bullough, L.W., Turrell, W.R., Buchan, P., and Priede, I.G. 1998. Commercial deep water trawling at sub-zero temperatures - Observations from the Faroe-Shetland channel. Fish. Res. 39: 33-41.

Commercial deep water trawling occurs north and west of Scotland on the continental slopes of the Faroe-Shetland channel (FSC) and the Rockall trough. From existing hydrographic knowledge, reported depths being fished in the FSC suggested that trawling was taking place in waters of zero or sub-zero temperatures. Fishing in deep water at these temperatures may be unique in terms of global commercial fisheries. Instrumentation of a Scottish deep water commercial trawler's net with a temperature and depth recorder showed that indeed some fishing time (*Reinhardtius hippoglossoides)* and Roughhead grenadier (*Macrourus berglax*) and most fishing time were associated with boundary waters in the range 0-4[deg]C. Variable conditions on a seasonal or shorter time scale were demonstrated as were changes in ambient water temperature of almost 6[deg]C during individual hauls. Sub-zero temperatures were recorded as shallow as 600 m whilst at the same depth modal haul temperature showed a range >6[deg]C. The variable and much colder conditions of the deep water in the FSC were contrasted with the stable and warmer conditions of the Rockall trough. Further research is required if management of this growing fishery is to be scientifically based.

Bundy, A., Lilly, G.R., and Shelton, P.A. 2000. A mass balance model of the Newfoundland-Labrador Shelf. Can.Tech. Rep. Fish. Aquat. Sci. 2310: 171 p.

A mass balance model using the Ecopath approach was constructed for the southern Labrador Shelf, northeast Newfoundland Shelf and Grand Bank in Northwest Atlantic Fisheries Organisation (NAFO) Divisions 2J+3KLNO for the period 1985-1987. The exercise effected a synthesis of information on biomass, consumption, production and diet of major species or species groups. The paucity of data on biomass and diet of many groups was emphasised. Information on productivity of lower trophic levels was especially weak. Major imbalances were found in the original model. Biomass estimates of some prey species were increased substantially to meet the food requirements of predators. Hooded seals were at the top of the food web. Other high level predators included Greenland halibut, harp seals, Atlantic cod. The dominant planktivorous fish was capelin, but Arctic cod and sand lance were also important.

Burmakin, V.V. 1978. Vliyanie temperatury vody na ulovy makrurusa i paltusa u Baffinovoj Zemli [Effect of water temperature on grenadier and halibut catches off Baffin Land]. *In* Okeanologicheskie issledovaniya severnogo bassejna [Oceanological investigations in the seas of the northern basin]. *Edited by* B.P.Kudlo. PINRO, Murmansk (USSR) pp. 148-152.
[In Russian]

Correlation analysis was made of the mean water temperature in the 200-500m layer of the Labrador Current at 2 stations across the north-eastern slope of the Grand Newfoundland Bank in May, the year-to-year temperature variations, and the grenadier and halibut catches in the Baffin Land area in September. Higher temperatures in the 200-500m layer of the main branch of the Labrador Current in spring were found to correspond to higher grenadier and lower halibut catches and vice versa. These relationships obtained on the basis of 7-year-long observation data are characterized by fairly high correlation coefficients and can be used for prediction purposes.

Burmakin, V.V. 1983. The effect of water temperature on grenadier and halibut catches off Baffin Island. Can. Transl. Fish. Aquat. Sci. 4915: 7 p.
[English translation from Russian
Original appeared in: Trudy Polynargo Nauchno-issledovatel'skogo Instituta Morskogo Pybnogo Khozyaistva; Okeanografii (PINRO). XL: 148-152, 1978 "Vliyanie temperatury vody na ulovy makrurusa i paltusa u Baffinovoj Zemli"]

This paper investigates the effect of temperature conditions on grenadier and halibut catches off Baffin Island. The water temperature in Standard Hydrological Section 7-A (through the northeastern slope of the Grand Banks), which intersects the main stream of the Labrador Current, has been taken as the temperature index. The average temperature of the 200-500 m layer was calculated from two stations of the section and adjusted to 15 May. It reflects the thermal state of the warm waters in the main stream of the Labrador Current and, in our opinion, depends on the temperature of the slope waters off Baffin Island, since the Baffin Island-Labrador current system must be considered as one. Grenadier and halibut concentrations are related to the temperature of the warm slope waters of the main stream of the Labrador Current (200-500 m layer), and thus the variations in the proportion of these two species in catches, and the size of the catches, must depend on temperature changes in the layer indicated.

Burreson, E.M. and Arthur, J.R. 1994. First North American record of the marine leech *Notostomum laeve* (Annelida: Hirudinea). J. Parasitol. 80: 820-822.

The Arctic marine leech *Notostomum laeve* is reported for the first time from North America. A single, small specimen was collected in April 1990 on the external surface of 1 of 30 Greenland halibut *Reinhardtius hippoglossoides* from Cumberland Sound, Baffin Island, Northwest Territories, Canada. Total length of the specimen including suckers is 41 mm; maximum body width is 1.8 mm. The species is easily identified by the unusual sucker. The caudal sucker is divided into 2 lateral halves that appear to close somewhat like a clam shell; the oral sucker is very thick and muscular with a row of small, hard teethlike papillae around the outer margin. On the basis of this report from northern Canada, N. laeve probably has a circumpolar distribution in the Arctic Ocean.

Burton, D. 1988. Melanophore comparisons in different forms of ambicoloration in the flatfish *Pseudopleuronectes americanus* and *Reinhardtius hippoglossoides*. J.Zool. (Lond.) 214:

353-360.

The melanophores associated with contrasting manifestations of ambicoloration in two species, winter flounder (*Pseudopleuronectes americanus*) and Greenland halibut (*Reinhardtius hippoglossoides*), from the Pleuronectidae are compared microscopically. Melanophores from the flounder blind side are morphologically similar to those from the ocular side in the different forms of ambicoloration, although there are differences in melanophore densities. In Greenland halibut, ambicoloration is a normal characteristic which is considered to be secondarily acquired. The melanophores of the ocular side of Greenland halibut are similar to the melanophores of other Pleuronectidae, whereas those of the blind side are very different in morphology and size.

Burton, M. 1998. Gametogenesis in north west Atlantic teleosts. *In* Proceeding of the ninth congress of European ichthyologists (CEI-9) Fish Biodiversity. Ital. J. Zool. 65 (Suppl.) 199-202.

Gametogenesis has been studied in oviparous teleosts including winter flounder (*Pleuronectes americanus*), American plaice (*Hippoglossoides platessoides*), 'turbot' (*Reinhardtius hippoglossoides*), capelin (*Mallotus villosus*), Atlantic salmon (*Salmo salar*), char (*Salvelinus alpinus*), and Atlantic cod (*Gadus morhua*). In the cold environment of the north west Atlantic prolonged gametogenesis may occur with variations in the rates of change and lengths of maintenance for different phases of the cycles. Staggered promotion can occur so that some fish have periods of short or prolonged asynchrony even when they eventually fit classical descriptions of synchronous gametogenesis. For winter flounder oogenesis fits expectations of a minimum three years overall with promotion into vitellogenesis 10-11 months before spawning, but for other species a shorter vitellogenic phase may occur. Fall-spawning salmonids may initiate gametogenesis much earlier than some reports previously suggested, and are asynchronous until close to spawning. Female winter flounder, salmonids and capelin spawn in a short burst whereas American plaice and Atlantic cod are batch spawners, as is Reinhardtius (contrary to a previous report). All the species studied have iteroparous females but capelin males are essentially semelparous; however iteroparous species have individuals which may not spawn every year.

Burton, M.P.M. 1998. Potential errors in measuring spawning stock biomass : determining the effects of non-participatory adults for some Atlantic groundfish species. NAFO SCR documents 98/93: 8 p.

Burton, M.P.M. 1999. Notes on potential errors in estimating spawning stock biomass: determining the effects of non-participatory adults for some groundfish species. J. Northwest Atl. Fish. Sci. 25: 205-213.

Using both old data sets and recent information there are indications that the estimates of spawning stock biomass have been over-optimistic for some commercially important groundfish species. The concept of non-participation had been used for adults, which undergo gametogenesis but fail to spawn successfully, or which have very low participation because fecundity is extremely low for an individual, in comparison to others of the same species. Interannual variability in production of fertilized eggs may also be due to the presence of adults which do not undergo gametogenesis every year and this situation may be much more common than has been previously accepted in setting up stock-recruitment models. Re-calculations of spawning stock biomass for some groundfish species using lower and more realistic participation rates should provide better understanding of stock-recruitment relationships.

Cadigan, N. 2000. QLSPA estimates of Greenland halibut stock size. NAFO SCR documents 00/23: 24 p.

SPA's for Greenland halibut in NAFO Divisions 2J and 3K are presented. These SPA's are intended to be illustrative only because of uncertainties about stock structure and the magnitude of the historical commercial catch that has been reported for this stock. Nonetheless, the illustrative SPA's presented in this paper should give some indication of the size of the Greenland halibut stock, and the problems associated with using SPA as an assessment tool for this stock. A series of SPA's are presented, starting with a simple model structure. For each SPA in the series only a few modelling assumptions are changed, and the effect of the changes are illustrated. The final SPA is fairly consistent with the stock size indices used for estimation, although the modelling assumptions required to produce this consistency are tenuous. This SPA suggests the 2000 stock biomass for ages 5-17 is 220 000 tons, which is the highest observed since 1975. The next highest biomass estimate is 210 000 tons in 1991.

Canada. Dept. of Fisheries and Oceans 1988. Atlantic fishes of Canada. Can. Bull. Fish. Aquat. Sci. 219: 761 p.

Canada. Dept. of Fisheries and Oceans 1988. Les poissons de l'Atlantique canadien [Atlantic fishes of Canada]. Can. Bull. Fish. Aquat. Sci. 219F: 2285 p.
[In French]

Canada. Dept. of Fisheries and Oceans 1991. A review of the management and fishery for Greenland halibut. Canada. Dept. of Fisheries and Oceans, Ottawa, ON. 99 p.

Canada. Dept. of Fisheries and Oceans 1992. Norwegian fisheries 1991. Can. Transl. Fish. Aquat. Sci. 5572: 21 p.
[Translated from Norwegian; Original appeared in Fiskets Gang. (1): 4-9, 1992]

The Norwegian fishermen landed in 1991 about 355,000 t more fish than in 1990. Provisional figures show that 162,000 t of cod were landed to a first-hand value of almost NOK 1.6 billion. In 1991, the Barents Sea was again open for both winter and fall capelin fishery. Norwegian fishermen landed 564,000 t of capelin, with a first-hand value of well over NOK 304 billion. We have to go back to 1985 to find capelin fishery figures higher than this. The figures show also that pollock and Greenland halibut fisheries were very good in 1991 and that a great upswing took place in the mackerel fishery. On the other hand, shrimping declined considerably both in quantity and in value, as did the blue whiting fishery.

Canada. Dept. of Fisheries and Oceans 1993. Report on the status of groundfish stocks in the Canadian Northwest Atlantic. Canada. Dept. of Fisheries and Oceans, Ottawa. 128 p.

Canada. Dept. of Fisheries and Oceans. 1995. Turbot wars news release [videorecording]. Ottawa, ON, Canada Dept. of Fisheries and Oceans. 1 videocassette.
[6:14 min.]

Includes news clips from the major English language television networks in Canada on the turbot dispute off Canada's East Coast. The Spanish vessel, the Estai, was seized by the Department of Fisheries and Oceans fisheries officers on the orders of Brian Tobin, Minister of Fisheries and Oceans in 1995. Mr. Tobin carried through on his decision to enforce fishery regulations outside the 200 mile zone. This led to international reaction, especially from European officials. The "Get off our nose and stay off our tail" slogan became popular in Canada.

Canada. Dept.of Fisheries and Oceans 1998. Canadian request for scientific advice on management in 1999 of certain stocks in Subareas 0 to 4. NAFO SCS documents 98/2: 2 p.

Canada. Dept. of Fisheries and Oceans 2005. Fishery management plan: Greenland halibut, NAFO Subarea 0, 2003-2005. Canada. Dept. of Fisheries and Oceans, Winnipeg, MB. 54 p.

This document outlines management approaches for the 2003 through 2005 Greenland halibut (a.k.a. turbot) fishery in the Northwest Atlantic Fisheries Organization (NAFO) Subarea 0. This area includes Canadian waters adjacent to Nunavut with the exception of a portion of Cumberland Sound.

Canada. Dept. of Fisheries and Oceans. Central and Arctic Region 2003. The Greenland halibut fishery in Baffin Bay and Davis Strait. 1 pamphlet.
[Also available in French and Inuktituk]

Canada. Dept. of Fisheries and Oceans. Newfoundland Region. Fisheries and Habitat Management Branch. 1991. Winter turbot fishery: Labrador. Project summary (Atlantic Fisheries Adjustment Program (Canada)). 33: 4 p.

Canada. Dept. of Fisheries and Oceans. Newfoundland Region. Resource Management Division 1986. Report on the 1986 German Democratic Republic (G.D.R.) roundnose grenadier fishery: observer program Newfoundland Region. 25 p.

The purpose of this report is to summarize the surveillance-related information collected and to provide analysis useful in monitoring this fishery, particularly in reference to the level of Greenland halibut (turbot) by-catch.

Canada. Dept.of Fisheries and Oceans. Newfoundland Region. Resource Management Division. 1987. Faroese longliner Greenland halibut (turbot) fishery, 1986. Canada. Dept. of Fisheries and Oceans. Newfoundland Region. Resource Management Division, St. John's, Newfoundland. 16 p.

The purpose of this report is to summarize the Faroese longliner fishery for Greenland halibut (turbot) within Canadian fisheries waters during 1986. The information contained in this report was obtained from the fisheries observers assigned to these vessels.

Canada. Dept. of Fisheries and Oceans. Policy and Economics Branch. 2002. Survey on the operating results of turbot fishermen (Greenland halibut) 1997-2000 : Quebec region. Economic analysis report. 156: 43 p.

The Policy and Economics Branch of Fisheries and Oceans Canada, Quebec Region, conducted this survey on the expenses incurred and income earned by Greenland halibut fishermen from the years 1998 to 2000. The current survey is an update of the "Economic Portrait of the Greenland Halibut Fishery" which focused on the 1997 exploitation year. The methodology used for this update is similar to the one used in 1997, which will allow a better comparison of the results. The study which was carried out incorporates three surveys conducted in 1998, 1999 and 2000. The average cash flows, the main characteristics of the fleets as well as the economic break-even points are also presented. Additionally, it is possible to observe the annual trends of each of these variables between 1997 and 2000 as well as the annual averages of each of the four fleets.

Canada. Dept. of Fisheries and Oceans. Quebec Region. Regional Science Branch and Canada. Dept. of Fisheries and Oceans. Gulf Region. Science Branch. 1995. Compilation of the reports on the status of groundfish stocks of the Gulf of St. Lawrence. DFO Atlantic fisheries stock status report 95/5: 114 p.

Canada. Ministère des pêches et des océans 1993. Rapport sur l'état des stocks de poissons de fond canadiens dans l'Atlantique nord-ouest. Canada. Ministère des pêches et des océans, Ottawa. 134 p.
[In French]

Canada. Ministère des pêches et des océans. Secretariat des evaluations de stocks de l'Atlantique. 1994. Rapport sur l'état des stocks de poissons de fond canadiens dans l'Atlantique nord-ouest. MPO Pêches de l'Atlantique rapport sur l'état des stocks 94/4: 198 p.
[In French]

Canada. Ministère des pêches et des océans.Region du Québec. 2002. Etude sur les résultats d'exploitation des turbotiers (Flétan noir) 1997-2000: region du Québec [Survey on the operating results of turbot fishermen (Greenland halibut) 1997-2000: Quebec region]. Rapport de l'analyse economique 156: 42 p.

The Policy and Economics Branch of Fisheries and Oceans Canada, Quebec Region, conducted this survey on the expenses incurred and income earned by Greenland halibut fishermen from the years 1998 to 2000. The current survey is an update of the "Economic Portrait of the Greenland Halibut Fishery" which focused on the 1997 exploitation year. The methodology used for this update is similar to the one used in 1997, which will allow a better comparison of the results. The study which was carried out incorporates three surveys conducted in 1998, 1999 and 2000. The average cash flows, the main characteristics of the fleets as well as the economic break-even points are also presented. Additionally, it is possible to observe the annual trends of each of these variables between 1997 and 2000 as well as the annual averages of each of the four fleets.

Canada/Newfoundland Inshore Fisheries Development Agreement. Underutilized Species Program. 1990. Harvesting deepwater turbot and grenadier. Project summary. 6: 4 p.

The objective of this project is to assess the feasibility of fishing large turbot in deep water using fixed gear on vessels less than 65 feet. Evidence that large turbot are available in deep water (600-900 m) in channels from 100-200 miles offshore along the Northeast coast of Newfoundland and Labrador has been available for years. This information has been used to advantage by foreign vessels. Turbot is considered an underutilized species. The annual total allowable catch (TAC) for turbot in Canadian waters is currently 73,000 tonnes. The total catch by Canadian vessels for 1989 was 15,408 tonnes, or 21% of the TAC. Foreign vessels took 15%. In 1989 and again in 1990, the Canada/Newfoundland Inshore Fisheries Development Agreement - Underutilized Species Program funded projects to assess the viability of a deep water turbot fishery using inshore less than 65 foot vessels.

Canada/Newfoundland Inshore Fisheries Development Agreement. Utilization of Fish Discards Program, Beothic Fish Processors Ltd., V.G. Associates, Canpolar East Inc., and Marylou Peters and Associates Limited 1992. Technical and marketing aspects of processing engawa from turbot (Greenland halibut). Canada/Newfoundland Inshore Fisheries Development Agreement. Utilization of Fish Discards Program, Canada. 63 p.

For the most part turbot (Greenland halibut) is processed into various fillet packs and blocks. In many plants what is not utilized that way simply goes to waste. This study was proposed with the aim of helping to eliminate some of that loss. The possibility of a market for a specific by product now being discarded during the processing of turbot had been identified. That by product is the portion of meat which is usually still attached to the fillet after skinning and afterwards removed and discarded. It forms part of the dorsal and ventral fin structure and is the strip of fatty but firm tissue commonly referred to as the

"frill". It is what the Japanese call "engawa". A project proposal was initiated to determine the acceptability of engawa from Newfoundland and the technical and economic viability of producing and marketing it. This was to be done with the minimum disruption to the normal turbot filleting operations at Beothic Fish Processors plant in Valleyfield.

Canadian Atlantic Fisheries Scientific Advisory Committee. 1979. CAFSAC report June 7 to 8, 1979. Can. Atl. Fish. Sci. Adv. Comm. Res. Doc. 79/8: 66 p.

Canadian Atlantic Fisheries Scientific Advisory Committee. 1980. Advice on groundfish stocks. Can. Atl. Fish. Sci. Adv. Comm. Res. Doc. 80/10: 20 p.

Canadian Atlantic Fisheries Scientific Advisory Committee. 1981. Advice on groundfish stocks. Can. Atl. Fish. Sci. Adv. Comm. Res. Doc. 81/8: 30 p.

Canadian Atlantic Fisheries Scientific Advisory Committee. 1982. Advice on the management of groundfish stocks in 1983. Can. Atl. Fish. Sci. Adv. Comm. Res. Doc. 82/13: 28 p.

Canadian Atlantic Fisheries Scientific Advisory Committee. 1983. Advice on the management of groundfish stocks in 1984. Can. Atl. Fish. Sci. Adv. Comm. Res. Doc. 83/19: 20 p.

Canadian Atlantic Fisheries Scientific Advisory Committee. 1984. Advice on the management of groundfish stocks in 1985. Can. Atl. Fish. Sci. Adv. Comm. Res. Doc. 84/14: 20 p.

Canadian Atlantic Fisheries Scientific Advisory Committee. 1985. Advice on the management of groundfish stocks in 1986. Can. Atl. Fish. Sci. Adv. Comm. Res. Doc. 85/14: 52 p.

Canadian Atlantic Fisheries Scientific Advisory Committee. 1986. Advice on the management of groundfish stocks in 1987. Can. Atl. Fish. Sci. Adv. Comm. Res. Doc. 86/17: 62 p.

Canadian Atlantic Fisheries Scientific Advisory Committee. 1987. Advice on the management of groundfish stocks in 1988. Can. Atl. Fish. Sci. Adv. Comm. Res. Doc. 87/16: 82 p.

Canadian Atlantic Fisheries Scientific Advisory Committee. 1988. Advice on the management of groundfish stocks in 1989. Can. Atl. Fish. Sci. Adv. Comm. Res. Doc. 88/17: 55 p.

Canadian Atlantic Fisheries Scientific Advisory Committee. 1991. Advice on the management of groundfish stocks. Can. Atl. Fish. Sci. Adv. Comm. Res. Doc. 91/13: 29 p.

Canadian Fishery Consultants Limited and Northwest Territories. Dept. of Economic Development and Tourism 1988. Report on Pangnirtung winter turbot fishery. Canadian Fishery Consultants Ltd., Halifax, N.S. 58 p.
[Title on cover: Pangnirtung Winter Turbot Fishery]

The Dept. of Economic Development and Tourism has assumed the lead role in the conservation of cultural traditions and the provision of alternative economic development of the Eastern Arctic. One of the objectives in sustainable development of renewable resources is to "Enhance present and future cultural and economic benefits through the sustainable use and development of renewable resources." The 1988 winter turbot fishery is one component of this objective and is the third consecutive year that GNWT has focused on the establishment of a winter fishery in Cumberland Sound and Pangnirtung. This report outlines activities during the 1988 fishing season and some preliminary conclusions.

Candow, J.E. and Corbin, C. 1997. How deep is the ocean : historical essays on Canada's Atlantic fishery. University College of Cape Breton Press, Sydney, N.S. 304 p.

The 18 essays included in this book examine the technologies that altered the fishery, the role of science and regulation in fisheries management, and the social and economic forces that have shaped communities in Canada. The essays in this collection were gathered at a critical time in the history of Canada's east coast fishery. Canada's problems became international front page news in 1995 when a Canadian Coast Guard ship fired at a Spanish trawler on the high seas in a dispute over the diminishing turbot (*Reinhardtius hippoglossoides*) stock. Fishers in extraordinary numbers were out of work, receiving government assistance, and staging protests about government regulations. The future of many eastern Canadian fishing communities looked particularly grim. The majority of the essays in this volume approach the subject from a Newfoundland perspective.

Casas, J.M. 2004. Results from bottom trawl survey on Flemish Cap of July 2003. NAFO SCR documents 04/21: 36 p.

A stratified-random bottom trawl survey on Flemish Cap was carried out from June 2nd to July 27th 2003 following the same procedures as in previous years. However the survey was carried out by the R/V Vizconde de Eza, which will continue for this survey in the future. For this reason during the first ten days of the survey a comparative fishing trial for calibration was conducted between the former vessel R/V Cornide de Saavedra and the new one. Taking into account that the calibration will continue during the next years survey, the indexes in the series from 1988 to 2002 were not changed to the new scale by now. Still, the 2003 current indices from the R/V Vizconde de Eza were transformed to the R/V Cornide de Saavedra scale, to make them comparable to the results obtained in previous years. Abundance at age indices was presented for cod, American plaice, redfish and Greenland halibut.

Casas, J.M. and Gonzales Troncoso, D. 2005. Results from bottom trawl survey on Flemish Cap of July 2004 . NAFO SCR documents 05/35: 35 p.

A stratified random bottom trawl survey on Flemish Cap was carried out from June 25th to August 2nd 2004. This year, the area surveyed was extended up to depths of 800 fathoms (1400 meters) following the same procedures as in previous years and increasing the number of hauls planned (195). The survey was carried out by the R/V Vizconde de Eza and the last eleven days of the surveys were used to make 61 paired hauls with the R/V Cornide de Saavedra and to conclude the comparative fishing trial for calibration initiated in 2003 between the former vessel and the new one. A total of 124 valid hauls were made by the vessel R/V Vizconde de Eza with the usual survey gear (Lofoten) up to 730 meters depth. Survey results including abundance indices of the main commercial species and age distributions for cod, redfish, American plaice and Greenland halibut are presented. The general indexes for this year are estimated taken into account the traditional swept area (strata 1-19, up to depths of 730 m.) and the total area surveyed (strata 1-34, up to depths of 1400 m.). From the comparative fishing trial carried out during 2003 and 2004, the correction factors for the main species were estimated and the indexes from 1988 to 2002 were corrected to the scale of the new vessel. In the same way the corrected abundance at age indices was presented for cod, American plaice, redfish and Greenland halibut.

Casey, J. 1995. Yield-per-recruit approximation for Greenland halibut in Subareas 2 and 3. NAFO SCR documents 95/66: 8 p.

Castell, J. D. 2003. Live feeds for haddock: what species and when? *In* Early rearing of haddock: state of the art. Proceedings of a workshop: 16-17 October 2002. *Edited by* Aiken, D.E. Aquaculture Association of Canada. St. Andrews, NB. AAC (Aquaculture Association of Canada) Special Publication. 7. pp. 63-70.

Marine fish species such as haddock (*Melanogrammus aeglefinus*), cod (*Gadus morhua*), halibut (*Reinhardtius hippoglossoides*), winter flounder (*Pseudoleuronectes americanus*) and yellowtail flounder (*Limanda ferruginea*) are being investigated in Canada and other countries as an alternative to salmonids in the aquaculture industry. One disadvantage of most marine fish is that their larval stages require live food organisms from first-feeding until the digestive system is sufficiently developed to cope with formulated feeds. Wild zooplankton, mostly various copepod species, are the natural diet of marine fish larvae and are the best food for first-feeding of marine fish larvae. Copepods have higher levels of vitamins, free amino acids and the essential long chain highly unsaturated fatty acids (HUFA) 2-:5n-3 and 22:6n-3 than do rotifers and *Artemia* nauplii. However wild copepods are costly to harvest, are not always abundant when required as live food for marine fish hatchery operation and are a potential source of disease, parasites or toxins such as paralytic shellfish poison (PSP). The nutritional value of rotifers and *Artemia* nauplii can be improved by enrichment with vitamins, n-3 HUFA and or minerals. They are relatively easy to produce in numbers necessary for commercial-scale marine fish hatchery operations. However, they still are not as good as copepods. Normal pigmentation and metamorphosis of several marine flatfish species still require copepod diets during a critical period in their larval development. Recent developments hold some promise for mass culture of copepods for marine fish culture. While calanoid copepods are preferred food for marine fish larvae because they occupy the same portion of the water column as the fish larvae, they have limited ability to elongate and desaturate dietary 18-carbon unsaturated fatty acids to the 20- and 22-carbon HUFA required by the marine fish and must have these HUFA preformed in their algal diets. Harpacticoid copepods can be produced at much higher densities and are capable of converting 18:3n-3 to 20:5n-6 and 22:6n-3. However, harpacticoid copepods tend to concentrate on the bottom and sides of the larval culture tank, making them less available as food for fish larvae compared with calanoids. While other live food organisms such as bivalve mollusc trocophores and cladocerans have been proposed as possible alternatives to rotifers and *Artemia*, none of these food organisms seems to be good as the various species of copepods.

Cespedes, A., Garcia, T., Carrera, E., Gonzalez, I., Sanz, B., Hernandez, P.E., and Martin, R. 1998. Polymerase chain reaction-restriction fragment length polymorphism analysis of a short fragment of the cytochrome b gene for identification of flatfish species. J. Food Prot. 61: 1684-1685.

Restriction site analysis of polymerase chain reaction (PCR) products from a conserved region of the cytochrome b gene has been used for the specific identification of sole (*Solea solea*), European plaice (*Pleuronectes platessa*), flounder (*Platichthys flesus)*, and Greenland halibut (*Reinhardtius hippoglossoides*). PCR amplification of the cytochrome b gene using a universal primer together with a primer specifically designed as a part of this study produced a 201-bp fragment in all species analyzed. Digestions of the PCR products with Sau3AI, BsmAI, RsaI, and MnlI endonucleases, followed by agarose gel electrophoresis of the digested PCR products, yielded specific profiles that enabled direct identification of each species analyzed.

Cespedes, A., Garcia, T., Carrera, E., Gonzalez, I., Fernandez, A., Hernandez, P.E., and Martin, R. 1999. Application of polymerase chain reaction-single strand conformational polymorphism (PCR-SSCP) to identification of flatfish species. J. AOAC Int. 82: 903-907.

A method of DNA analysis based on polymerase chain reaction-single strand conformational polymorphism (PCR-SSCP) was developed to verify the authenticity of labeled raw and frozen fillets of some flatfish species. PCR was used to amplify a short fragment (201 bp) of the mitochondrial cytochrome b gene, which was denatured and analyzed by native polyacrylamide gel electrophoresis for detection of SSCPs. Species-specific patterns of DNA bands were obtained for sole (*Solea solea)*, European plaice

(*Pleuronectes platessa*), flounder (*Platichthys flesus*), and Greenland halibut (*Reinhardtius hippoglossoides*).

Cespedes, A., Garcia, T., Carrera, E., Gonzales, I., Fernandez, A., Heranandez, P.E., and Martin, R. 1999. Identification of sole (*Solea solea*) and Greenland halibut (*Reinhardtius hippoglossoides*) by PCR amplification of the 5S rDNA gene. J. Agric. Food Chem. 47: 1046-1050.

Polymerase chain reaction (PCR) amplification of the nuclear 5S rDNA gene, has been used for the identification of sole (*Solea solea*) and Greenland halibut (*Reinhardtius hippoglossoides*). Two species-specific primers were designed to amplify specific fragments of the 5S rDNA gene in each species. The remarkably different size of the amplicons obtained gives, by simple agarose gel electrophoresis, two distinguishable band patterns for both flatfish species. This genetic marker can be very useful for the accurate identification of *S. solea* and Greenland halibut, to enforce labeling regulations.

Cespedes, A., Garcia, T., Carrera, E., Gonzalez, I., Fernandez, A., Asensio, L., Hernandez, P.E., and Martin, R. 1999. Indirect enzyme-linked immunosorbent assay for the identification of sole (*Solea solea)*, European plaice *Pleuronectes platessa*), flounder (*Platichthys flesus*), and Greenland halibut (*Reinhardtius hippoglossoides*). J. Food Prot. 62: 1178-1182.

Polyclonal antibodies produced against soluble muscle protein extracts from sole (Solea solea), European plaice (*Pleuronectes platessa*), flounder (*Platichthys flesus*), and Greenland halibut (*Reinhardtius hippoglossoides*) were used in an indirect enzyme-linked immunosorbent assay for the specific identification of fillets from these flatfish species. The assay was performed in two different formats: microtiter plates and immunostick tubes. Inummorecognition of antibodies adsorbed to their specific fish samples was made with goat antirabbit immunoglobulins conjugated to the enzyme horseradish peroxidase. Subsequent enzymatic conversion of the substrate allowed unequivocal identification of all flatfish species studied.

Cespedes, A., Garcia, T., Carrera, E., Gonzalez, I., Fernandez, A., Asensio, L., Hernandez, P.E., and Martin, R. 2000. Genetic differentiation between sole (*Solea solea)* and Greenland halibut (*Reinhardtius hippoglossoides*) by PCR-RFLP analysis of a 12S rRNA gene fragment. J. Sci. Food Agric. 80: 29-32.

PCR-RFLP analysis was applied to the identification of two closely related flatfish species: sole (*Solea solea*) and Greenland halibut (*Reinhardtius hippoglossoides*). Amplification of DNA isolated from muscle samples was carried out using a set of primers flanking a 321-bp region from the mitochondrial 12S rRNA gene. Restriction endonuclease analysis based on sequence data of this DNA fragment revealed the presence of polymorphic sites for AciI and MwoI endonucleases. The restriction profiles obtained by agarose gel electrophoresis when amplicons were cut with AciI and MwoI enzymes allowed the unequivocal identification of sole and Greenland halibut species.

Chamut, P.S. 1999. Canadian request for scientific advice on management in 2000 of certain stocks in Subareas 0 to 4. NAFO SCS documents 99/1: 2 p.

Chamut, P.S. 2000. Canadian request for scientific advice on management in 2001 of certain stocks in Subareas 0 to 4. NAFO SCS documents 00/1: 2 p.

Chamut, P.S. 2001. Canadian request for scientific advice on management in 2002 of certain stocks in Subareas 0 to 4. NAFO SCS documents 01/2: 2 p.

Chamut, P.S. 2002. Canadian request for scientific advice on management in 2003 of certain stocks in Subareas 0 to 4. NAFO SCS documents 02/3: 2 p.

Chamut, P.S. 2003. Canadian request for scientific advice on management in 2004 of certain stocks in Subareas 0 to 4. NAFO SCS documents 03/2: 2 p.

Chamut, P.S. 2004. Canadian request for scientific advice on management in 2005 of certain stocks in Subareas 0 to 4. NAFO SCS documents 04/2 (Rev.): 2 p.

Chernova, N.V. and Neyelov, A.V. 1995. Fish caught in the Laptev Sea during the cruise of RV "Polarstern" in 1993. Ber. Polarforsch. 176: 222-227.

This paper presents a list of marine fish species caught during the cruise of RV "Polarstern" to the Laptev Sea in 1993. In total, 34 species of 21 genera and 6 orders were identified. 12 species were found for the first time in the Laptev Sea, 2 additional species had been listed as questionable for the Laptev Sea has been extended for about one fourth, and the number of marine species has been doubled.

Chiperzak, D.B., Saurette, F., and Raddi, P. 1995. First record of Greenland halibut (*Reinhardtius hippoglossoides*) in the Beaufort Sea (Arctic Ocean). Arctic 48: 368-371.

Eleven Greenland halibut (*Reinhardtius hippoglossoides*) were captured in two longline sets in the offshore waters (71 degree 45'N, 127 degree 08'W) of Sachs Harbour, Banks Island, Northwest Territories. This is the first record of Greenland halibut in the Beaufort Sea and Arctic Ocean. The Greenland halibut were captured in the Atlantic water layer of the Beaufort Sea at a depth of approximately 430 m, with a temperature of 0.3 degree C and salinity of 34.8 ppt.

Chouinard, G.A. Distribution of groundfish and herring during the 1994 Cabot Strait survey. DFO Atlantic fisheries research document 94/68, 24 p.

A groundfish survey was conducted in Cabot Strait (NAFO Division 4T to Unit Area 4Vsb) area from January 13-25, 1994. Distribution of catches for the survey for 6 species (cod, redfish, white hake, American plaice, witch flounder and Greenland halibut) of groundfish and herring are presented along with information from a survey conducted by Quebec Region at the same time. For cod, two sets yielded more than one tonne but the remainder of the catches were largely less than 100 kg. Length distribution on a set by set basis for cod indicate some gradient in size with larger fish found to the south and smaller cod to the north. The distribution according to depth for herring, cod, white hake and redfish shows that these species had somewhat distinct preferred depth ranges. Herring were found in waters less than 5 deg C, redfish and the flatfish species in waters slightly above 5 deg C. The largest catch of cod was made at the highest bottom temperature observed. Distribution of many of the groundfish species appears to be continuous between area 4T and 4Vn in winter. For white hake, witch flounder and to some extent Greenland halibut (turbot), the current management unites do not account for the winter distribution.

Christensen, S. 1991. Denmark (Greenland) request for scientific advice on management of certain stocks in 1992. NAFO SCS documents 91/4: 2 p.

Chumakov, A.K. 1969. Fishing and tagging of Greenland halibut *Reinhardtius hippoglossoides* (Walbaum) near Iceland. Vopr .Ikhtiol. 9: 1128-1131.
[In Russian]

Chumakov, A.K. 1975. K voprosu o lokal'nosti stad chernogo paltusa v severo-zapadnoj Atlantike [A contribution to the problem of stock identification in Greenland halibut from the Northwest Atlantic]. *In* Sostoyanie i perspektivy syr'evoj bazy rybolovstva severnogo bassejna [The state and prospects of fisheries resources in the Northern basin] *Edited by* Konstantinov, K.G. Tr. PINRO. v. 35.

[In Russian]

On the basis of changes in the relative numbers of mature and immature fish in the shelf and the continental slope areas of the Northwest Atlantic it is suggested that Greenland halibut are likely to perform migrations from the southern part of their distribution area to the spawning area in the Davis Strait. Data on the size composition and the male female ratio obtained during the summer-autumn period on the shelf and the continental slope are considered by depths and areas. It is believed that the Greenland halibut occurring in the Grand Bank, Labrador and Baffin I areas belong to one population with a common spawning area while those from West Greenland belong to a different population with spawning grounds in the Denmark Strait.

Chumakov, A.K. 1977. Localities of Greenland halibut stocks in the North-west Atlantic. Can. Transl. Fish. Aquat. Sci. 3916: 9 p.
[Transl.of: K voprosu o lokal'nosi stad chornogo paltusa v severo-zapadnoi Atlantike. From: Trudy Polar Sci. Res. Inst. Sea Fish. Oceanogr., (no.35), 203-208]

In an attempt to establish the locality of Greenland halibut (*Reinhardtius hippoglossoides*) stocks, biological characteristics (maturity, size, sex ratio) of halibut on the shelf are compared to those of halibut on the continental slope. Greenland halibut inhabiting areas of the Grand Banks, Labrador, and Baffin Island belong to the same population. The halibut of West Labrador apparently belong to another population, the spawning grounds of which are located in the Denmark Strait.

Chumakov, A.K. 1979. Abundance and biomass of Greenland halibut in ICNAF Divisions 2J and 3K in November-December 1978. ICNAF Res. Doc. 79/VI/103: 16 p.

Chumakov, A.K. 1981. Trawl survey of Greenland halibut stocks in the Northwest Atlantic (Subareas 0 and 2 and Division 3K) from 23 November 1980 to 30 January 1981. NAFO SCR documents 81/9/95: 16 p.

The methods of assessment of Greenland halibut abundance and biomass used during trawl surveys and the most suitable terms for their conducting are considered in the paper. The results of the investigations on absolute abundance and biomass of Greenland halibut obtained on MB-0422 "Nikolai Kononov" from 23 November 1980 to 30 January 1981 in the Canadian zone of the North Atlantic are given.

Chumakov, A.K. 1982. O tralovoj s' emke zapasov chernogo paltusa v kanadskoj zone Severnoj Atlantiki [A trawl survey of the Greenland halibut stocks in the Canadian zone of the North Atlantic]. *In* Chislennost' I Obraz Zhizni Promyslovykh Ryb Severo-Zapadnoj Atlantiki [Abundance and mode of life of commercial fishes from the Northwest Atlantic]. Sb. Nauch. Tr. PINRO., pp. 21-31.
[In Russian]

The period from November to January is the most favourable for trawl surveys of halibut (*Reinhardtius hippoglossoides*). The survey conducted here indicated the total biomass of 308,537 tons on the shelf and 831,907 tons on the continental slope. The average weight of an individual from the shelf was almost 3 times higher than of that from the slope. High abundance and biomass of Greenland halibut from the continental slope of the Baffin Island and the northern and central Labrador Sea allows for an increase of the total allowable catch of Greenland halibut in this area with allocations for each subarea. The results of investigations are indicative of a general increase in the abundance and biomass of Greenland halibut in this area with allocations for each subarea. The results of investigations are indicative of a general increase in the abundance and biomass of Greenland halibut in 1977-1981.

Chumakov, A.K. and Podrazhanskaya, S.G. 1986. Feeding of Greenland halibut (*Reinhardtius hippoglossoides*) in the Northwest Atlantic. Northwest Atl. Fish. Organ. Sci. Counc. Stud. 10: 47-52.

The seasonal feeding of Greenland halibut (*R. hippoglossoides*) in the shelf and slope areas of the Northwest Atlantic from Davis Strait to eastern Newfoundland was studied from the field analysis of 76,700 stomachs during surveys in 1969-81. Consumption of the various food organisms seems to be closely associated with their distribution and the bathypelagic way of life of Greenland halibut. The daily food requirements of both male and female Greenland halibut were estimated to range from 1.2% of body weight at age 5 to 0.5% at ages 14-17 years. Quantitatively, females need more food than males of the same age. Use of minimum estimates of stock size from a bottom-trawl survey of the region implies that the population consumes more than 750,000 tons of food annually.

Chumakov, A.K. and Postolaky, A.I. 1979. On the USSR fisheries of Greenland halibut and roundnose grenadier in the Davis Strait area. ICNAF Res. Doc. 79/VI/126: 6 p.

Chumakov, A.K. and Savvatimsky, P.I. 1983. On the Greenland halibut by-catch in the directed fishery for roundnose grenadier on the Labrador continental slope and in Davis Strait (NAFO Subareas 0, 1, 2 and 3K). NAFO SCR documents 83/91: 12 p.

The distribution of roundnose grenadier overlaps that of Greenland halibut, and in this connection bottom-trawl catches taken by commercial vessels are of mixed character. In winter/spring, the grenadier concentrations inhabit depths greater than 1000 m. In this period, Greenland halibut constitute the bulk of catches (60-70%) in Subareas 2 and 3, whereas in summer/autumn it is the roundnose grenadier who do it. In Subareas 0 and 1 the proportion of the halibut in the catches increases as summer approaches winter. As trawled depths increase from 500 to 1000 m, the grenadier-halibut ratio varies negligibly.

Chumakov, A.K. and Savvatimsky, P.I. 1984. Roundnose grenadier - Greenland halibut ratio in bottom trawl catches taken in NAFO area in 1970-1983. NAFO SCR documents 84/6/37: 15 p.

Bottom catches taken by commercial ships deeper than 500 m on the continental slope of the Baffin Island, Labrador and Newfoundland are composed mainly of roundnose grenadier and Greenland halibut because the areas of their distribution coincide. In the catches of commercial ships for 1973-1981 and in those of scouting and research ships for 1970-1983, Greenland halibut averaged 40.9% and 48.4%, respectively. The highest percentage of halibut in the catches is observed in Subareas 0 and 2, a smaller one - in Subarea 3, grenadier being the main fishing object in summer-autumn, because their concentrations at that time are at shallower waters, thus being more available for fishery. With the depth increasing from 400 to 110 m in Divs. OB, 2C, 2H, 2J the variations of the ratio of grenadier and halibut are not great, while in Div. 3K they are more prominent. The increase of Greenland halibut percentage in the catches taken recently, especially in the northern part of the continental slope of Canada, is observed, which is, apparently, connected with the increase in their abundance.

Chumakov, A.K. and Savvatimsky, P.I. 1987. Distribution of Greenland halibut and roundnose grenadier in the northwest Atlantic in relation to hydrographic conditions in 1968-1986. NAFO SCR documents 87/93: 38 p.

Chumakov, A.K. and Savvatimsky, P.I. 1990. Distribution of Greenland halibut (*Reinhardtius hippoglossoides*) and roundnose grenadier (*Coryphaenoides rupestris*) in the Northwest Atlantic in relation to hydrographic conditions in 1968-86. Northwest Atl. Fish. Organ. Sci. Counc. Stud. 14: 51-65.

The directed fishery for Greenland halibut (*Reinhardtius hippoglossoides*) and roundnose grenadier (*Coryphaenoides rupestris*) on the continental slope of the Northwest Atlantic began in 1967. The distribution of these species in NAFO Subareas 0, 1 and 2 and in Div. 3K was investigated in relation to hydrographic conditions in the South Labrador area (Section 8-A) and the factors affecting the formation and stability of commercial concentrations were considered. Data are presented to suggest that the ice edge location and research surveys conducted 1-2 months in advance of the fishery can be used to predict the thermal state of the waters and the conditions for the Greenland halibut fishery in the Baffin Island area.

Chumakov, A.K. and Serebrov, L.I. 1978. The determination of the catchability coefficient of bottom trawl for cod and Greenland halibut. ICNAF Res. Doc. 78/VI/24: 8 p.

Chumakov, A.K. and Serebryakov, V.P. 1982. Distribution of Greenland halibut from the Greenland-Canadian population. NAFO SCR documents 82/96: 12 p.

This paper considers juvenile and adult Greenland halibut distribution in Divisions of the Northwest Atlantic. The population structure of halibut, i.e. size-age composition, sex ratio is analysed. Information confirming the fact that mature individuals of halibut migrate northward from the southern parts of the area is also adduced. A prolonged period of passive drift of Greenland halibut eggs and larvae promotes a rather broad distribution of the Greenland-Canadian population of this species along the coast of North America and west Greenland. The paper considers a question on organizing a rational fishery of halibut in the Northwest Atlantic as a single population taking into account their distribution, size-age and sex composition.

Chumakov, A.K. and Soshin, S.M. 1991. Results of stratified random bottom trawl and long-line survey on Greenland halibut in NAFO Div. 0B in 1990. NAFO SCR documents 91/66: 11 p.

The aim of the paper is to describe a long-line selectivity in comparison with a trawl one and to compare a catch per effort by a long-line and a halibut abundance estimation by a trawl on the land slope as well as to study the influence of the other factors (kind of bait, degree of satiety, and a period of 24-hours) on the long-line catchability.

Chumakov, A.K., Shafram, I.S., and Tretjak, V.L. 1978. Assessment of Greenland halibut abundance and biomass in Statistical Area 0 and Subarea 1 with application of the virtual population method. ICNAF Res. Doc. 78/VI/53: 8 p.

Catches in deliberately "lost" gillnets were studied during a ten-day cruise conducted at Storegga 70 nm off the coast of mid-Norway in July 2000. Gillnet fleets were deployed at depths of between 537 and 677 m, and soak time varied from one to seven days. Four fleets set 45 days earlier were also retrieved during the cruise. Most of the catch (94 %) consisted of the target species Greenland halibut (*Reinhardtius hippoglossoides*). All individuals were categorized according to seven condition stages ranging from "alive with no injuries" to "only bones remaining". Results revealed that fish could be fully decomposed/consumed within a 24-hour period, probably due to amphipod and isopod scavenger activity. A decline in total catches was first observed after five days whereas catch composition remained stable during the first seven days. After 45 days a relatively high total catch was obtained but only 25 % were still at stages 1-4 (consumable). The cumulative catch after 45 days was estimated at 2.7 and 3.0 tons on the basis of two different methods. Gillnets retrieved after 45 days were evaluated as being highly effective, with gear saturation being the only factor leading to decreased efficiency.

Chumakov, A.K., Nikeshin, K.N., and Gorshkova, A.S. 1981. Bottom trawl cod-end selectivity for Greenland halibut in NAFO Subarea 0 and Div. 2H, 2J and 3K. NAFO SCR documents

81/89: 21 p.

Data on results of assessment of selective features of cod-ends with 117, 124, 127 and 133 mm mesh sizes in Greenland halibut (*Reinhardtius hippoglossoides*) fishing conducted with bottom trawls are represented in the paper.

Chumakov, A.K., Borovkov, V.A., and Noskov, A.S. 1984. USSR research report for 1983. NAFO SCS documents 84/VI/17: 41 p.

Chumakov, A.K., Poletaev, V.A., and Noskov, A.S. 1985. USSR research report for 1984. NAFO SCS documents 85/14: 25 p.

Chumakov, A.K., Borovkov, V.A., and Noskov, A.S. 1986. USSR research report for 1985. NAFO SCS documents 86/17: 32 p.

Chumakov, A.K., Borovkov, V.A., and Noskov, A.S. 1987. USSR research report for 1986. NAFO SCS documents 87/15: 39 p.

Chumakov, A.K. and Bowering, W.R. 1988. Post-stratified biomass and abundance estimates of Greenland halibut from USSR surveys in Subareas 0+2 and Division 3K. NAFO SCR documents 88/41: 20 p.

Chumakov, A.K., Bowering, W.R., and Ernst, P. 1988. Distribution of Greenland halibut (*Reinhardtius hippoglossoides* Walbaum) in the northwest Atlantic depending on bottom temperature. NAFO SCR documents 88/89: 20 p.

Chumakov, A.K., Rikhter, V.A., and Sigaev, I.K. 1989. USSR research report for 1988. NAFO SCS documents 89/8: 23 p.

Contents: 1. PINRO investigations in NAFO Convention Area in 1988; 2. Report of Soviet investigations in NAFO Subarea 4 in 1988

Chumakov, A.K., Borovkov, V.A., and Rikhter, V.A. 1990. USSR research report for 1989. NAFO SCS documents 90/05: 21 p.

Chumakov, A.K., Rudneva, G.B., Ernst, P., and Muller, H. 1990. Status of Greenland halibut (*Reinhardtius hippoglossoides* Walb.) stocks and feasible yield in NAFO Subareas 0, 1 and Div. 2GH. NAFO SCR documents 90/52: 18 p.

In the present paper we made an attempt to estimate the Greenland halibut stocks in Subareas 1, 0 and Divs. 2GH on the basis of joint USSR-GDR biological data and fisheries statistics from the countries fishing in these areas.

Chumakov, A.K., Bowering, W.R., and Ernst, R. 1992. Raspredelenie chernogo paltusa (*Reinhardtius hippoglossoides* Walbaum) v severo-zapadnoj Atlantike v zavisimosti ot pridonnoj temperatury vody [Distribution of Greenland halibut (*Reinhardtius hippoglossoides* Walbaum) in the Northwest Atlantic in relation to bottom water temperature]. *In* Issledovaniya Bioresursov Severnoj Atlantiki [Studies of Biological Resources in the North Atlantic]. *Edited by* P.I.Savvatimskij. Sbornik nauchnykh trudov Polyarnogo nauchno-issledovatel'skogo instituta morskogo rybnogo khozyajstva i okeanografii, Murmansk, Russia pp. 5-30.
[In Russian]

Relationship between the distribution of halibut (*Reinhardtius hippoglossoides*) and bottom water temperature is considered on the basis of biological material collected during trawl surveys by Soviet and Canadian research vessels in NAFO Subareas 0, 1, 2 and 3 from 1977 to 1987 and data from GDR fishing vessels. An attempt is made to find out consistent distribution patterns of halibut at different stages of the life cycle in relation to bottom water temperature and to specify data on the dynamics of extreme and preferred temperatures in different seasons.

Clarke, R.M. 1993. An overview of Canada's Arctic marine fisheries and their management with emphasis on the Northwest Territories. Can. Bull. Fish. Aquat. Sci. 226: 211-241.

Canada's Arctic marine fisheries are conducted primarily by aboriginal peoples and are of great importance to them. The subsistence fisheries provide for the continuation of their traditional cultures and supply a considerable portion of their food, the replacement value of which is about $15 million. The main species harvested in the fisheries are scallops (*Chlamys islandicus*), shrimp (*Pandalus* spp), Atlantic salmon (*Salmo salar*), Arctic charr (*Salvelinus alpinus*), whitefishes (*Coregonus* spp), Greenland halibut (*Reinhardtius hippoglossoides*), beluga (*Delphinapterus leucas*), narwhal (*Monodon monoceros*), walrus (*Odobenus rosmarus*) and seals (*Phocidae*). The fisheries are managed cooperatively by resource managers and resource users. Formal cooperative management boards that have specific decision-making responsibilities exist in some areas. Further development of fisheries is a goal of native groups and governments; however, biological productivity is low, economic potential is limited and infrastructure is lacking.

Cleary, L. 1979. Flatfish of the Scotian Shelf. CAFSAC Res. Doc. 79/27: 49 p.

Comeau, G.J. and Cook, J. 2002. Selected themes on Canada's freshwater and northern fisheries : interim report of the Standing Senate Committee on Fisheries. Standing Committee on Fisheries, Ottawa, ON. 62 p.
[Includes Media Advisory Title: Increased research in support of fisheries co-management in Nunavik, Nunavut and or Northwest Territories : February 2002]

In keeping with its mandate and recognizing the value of visiting Canada's regions, the Standing Senate Committee on Fisheries conducted a series of informal meetings in 2000 and 2001 to better familiarize its members with the freshwater and northern fisheries. The area under consideration in this report included a large part of the Department of Fisheries and Oceans' Central and Arctic Region. There was a limited scope to Lake Winnipeg and Canada's Arctic region (Nunavut, the Northwest Territories, and Nunavik) because of the Region's expanse and extreme diversity in terms of climatic conditions, fish species, fish habitat, demographics, fishing activity, and because of the many government jurisdictions involved. A working group of Committee members participated in discussions that took place in boardroom-type settings and in the form of on-site visits in Manitoba, Northwest Territories, and Nunavut. Another group traveled to Nunavik. Deliberations were later supplemented by more formal and recorded hearings in Ottawa. This document sketches out what Committee members heard. The Committee's 12 recommendations are included in both the Media Advisory and main text.

Comeau, G.J. and Cook, J. 2002. Thèmes choisis sur les pêches en eau douce et les pêches du nord : rapport interim du Comité senatorial permanent des pêches [Selected themes on Canada's freshwater and nrothern fisheries : interim report of the Standing Senate Committee on Fisheries]. Comité permanent des pêches, Ottawa, ON. 65 p.
[In French - Cover title: Rapport du Comité senatorial permanent des pêches]

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Comesana, A.S., Abella, P., and Sanjuan, A. 2003. Molecular identification of five commercial flatfish species by PCR-RFLP analysis of a 12S rRNA gene fragment. J. Sci. Food Agric. 83: 752-759.

Refrigerated or frozen fillets of commercial flatfish species are sometimes mislabelled, and identification of those products is needed to avoid fraudulent substitution. Molecular identification of five commercial flatfish species (order Pleuronectiformes), ie *Lepidorhombus whiffiagonis* (megrim), *Platichthys flesus* (flounder), *Reinhardtius hippoglossoides* (Greenland halibut), *Scophthalmus maximus* (turbot) and *Solea vulgaris* (= *S solea*) (sole), has been carried out on the basis of the amplification of an approximately 433bp segment from the mitochondrial 12S rRNA gene using the polymerase chain reaction (PCR) and universal primers. Direct DNA sequencing from two PCR products for each flatfish species was carried out, and sequences were used to select six restriction enzymes. PCR products of 15 individuals of each species were cut with each enzyme, resulting in species-specific restriction fragment length polymorphism (RFLP). The five flatfish species could be identified by application of the restriction enzyme AluI as well as by using different combinations of a pair of enzymes, ie DdeI and either AciI or MwoI. No intraspecific genetic polymorphism was found for any of the six enzymes. Results confirmed the usefulness of this technique to distinguish and genetically characterise refrigerated or frozen pieces of these five flatfish species.

Conseil pour la conservation des ressources halieutiques (Canada) 1994. Rapport au Ministre des pêches et des océans sur le flétan du Groenland dans les sous-zones 0, 1, 2 et 3. Conseil pour la conservation des ressources halieutiques (Canada), Ottawa. 19 p.
[In French]

Conseil pour la conservation des ressources halieutiques (Canada) and Canada. Ministère des pêches et des océans. 1998. La conservation : une obligation, et non pas une option : rapport annuel du Conseil pour la conservation des ressources halieutiques et impératifs de conservation pour les stocks de poisson de fond de l'Atlantique en 1998. Conseil pour la conservation des ressources halieutiques (Canada) CCRH.98.R.2, 90 p.
[In French]

Conseil pour la conservation des ressources halieutiques (Canada) and Canada. Ministère des pêches et des océans. 1999. Les pêches en transition : rapport annuel du Conseil pour la conservation des ressources halieutiques et impératifs de conservation pour les stocks de poisson de fond de l'Atlantique en 1999. Conseil pour la conservation des ressources halieutiques (Canada) CCRH.99.R.4: 216 p.
[In French]

Conseil pour la conservation des ressources halieutiques (Canada) and Canada. Ministère des pêches et des oceans. 2000. Des eaux inexplorées : rapport annuel du Conseil pour la conservation des ressources halieutiques et impératifs de conservation pour les stocks de poisson de fond de l'Atlantique en 2000. Conseil pour la conservation des ressources halieutiques (Canada) CCRH.2000.R.5: 186 p.
[In French]

Cornus, H.P. 1999. Die bewirtschafteten Fischbestaende im Nordwestatlantik. Eine Einschaetzung des Wissenschaftsrates der NAFO vom Juni 1999 [The managed fish stocks in the Northwest Atlantic. Assessment of the Scientific Council of the NAFD in June, 1999]. Inf .Fischwirtsch. Fischereiforsch 46: 24-26.
[In German]

Cornus, H.P., Ernst, P., Rätz, H.J., and Stein, M. 1992. German research report for 1991. NAFO SCS documents 92/17: 7 p.

Cornus, P., Rätz, H.J., and Stein, M. 1993. German research report for 1992. NAFO SCS documents 93/12: 3 p.

Crawford, R. 1990. On the Davis Strait/Cumberland Sound Greenland halibut (*Reinhardtius hippoglossoides* Walbaum): its biology and its fisheries. Arctic Fisheries Scientific Advisory Committee background document 90/91-02, 29 p.

The Greenland halibut (*Reinhardtius hippoglossoides*) is a mesopelagic piscivorous predator that is the object of an international fishery in Davis Strait that uses bottom trawls, longlines, and gill nets. Since 1987, this fish has also supported a winter fishery in Cumberland Sound. Indigenous fishermen, operating from snow machines and sleds, set longlines through ice. They fish in depths between 600-1200 m. The halibut they catch are predominantly age 9-12. Young inhabit nursery areas on the banks along both sides of Davis Strait. As they approach sexual maturity, which they attain at about age 10-12, they seek deeper water. Mature females are larger than males. They spawn in spring primarily on the Continental slope and in deep basins (650-1000+ m), such as Cumberland Sound. Currents distribute larvae along West Greenland and Baffin Island where they settle in the nursery grounds on the banks. It is postulated that the fish in Cumberland Sound are a component of a larger population in habiting Davis Strait.

Crawford, R. 1990. Update on the Baffin Island turbot fishery. Arctic Fisheries Scientific Advisory Committee background document 89/90-09, 10 p.

This paper is a synopsis of the status of the Baffin Island turbot (Greenland halibut - *Reinhardtius hippoglossoides*) commercial fishery. It is an update to the report presented to AFSAC in 1989 (Crawford and Dahlke 1989). Its purpose is to summarize the results of the 1989 fishery and to report ongoing efforts to research the turbot stocks in the eastern Arctic.

Crawford, R. and Dahlke, L. 1988. Greenland halibut of the inshore eastern Arctic: a background paper prepared for AFSAC. AFSAC background document 88/89-04: 14 p.

Crawford, R.E. 1992. Life history of the Davis Strait Greenland halibut, with reference to the Cumberland Sound fishery. Can. Manuscr. Rep. Fish. Aquat. Sci. 2130: 23 p.

The Greenland halibut (*Reinhardtius hippoglossoides* Walbaum) is an amphiboreal, mesopelagic piscivorous predator. In Davis Strait, it is the object of an international fishery which uses bottom trawls, longlines, and gill nets. Young Greenland halibut inhabit nursery areas on the banks along both sides of the strait. In 1987, a winter fishery for this species began in Cumberland Sound (Baffin Island). Indigenous fishermen, operating from snow machines and sleds, set longlines through ice. They fish in depths between 600-1125 m. Their catch is predominantly female, aged 9-12. It is postulated that the fish in Cumberland Sound are a component of the larger population inhabiting Davis Strait.

CTV Television Network and Canadian Broadcasting Corporation. English Television Network. 1995. [Atlantic fish stock depletion and dispute] [videorecording]. 1 videocassette.
[1.30 min., 7 min.: sd., col. : VHS]

This video contains two news clips concerning the depletion of cod fish stocks in Newfoundland. The first clip (from CTV-TV Canada AM) is a business commentary which points out that short-sighted greed and overfishing are contributing to the decline of cod and that government regulations are needed to preserve the fish stocks. The second clip (from CBC-TV Newfoundland Morning News) features an interview with Carlos Pimenta, Portugese member of the European Parliament. Mr. Pimenta makes the case that Europe could retaliate if Mr.Tobin, Minister of Fisheries and Oceans, seized any ships fishing turbot in international waters outside Canadian waters. Both news clips were aired on March 8, 1995.

Cusimer (1991) Inc. and Programme d'essai et d'expérimentation halieutiques et aquicoles (Canada). 1994. Essais de valorisation de l'engawa. Rapport final (Programme d'essai et d'experimentation halieutiques et aquicoles (Canada) 156 : 29 p.
[In French]

Ce projet visait les objectifs spécifiques suivants: établir la faisabilité de récupérer l'engawa au cours des opérations coutumières du processus de transformation du flétan du Groenland, catégoriser les produits selon les spécifications des marchés, développer un emballage et un étiquetage pour répondre aux besoins des marchés, développer un mode de transport économique et rapide afin d'acheminer le produit fini jusqu'aux marchés, identifier les acheteurs potentiels, effectuer une production pilote. Les résultats présentés font état d'un suivi méthodique des objectifs précités et révélent de bonnes possibilités commerciales pour le produit concerné. À la suite de la définition des procédés, nous avons réalisé l'analyse des côuts et évalué la viabilité du produit en production industrielle.

D'yakov, Y.P. 1981. K Morfometricheskoj Kharakteristike Tikhookeanskogo Chernogo Paltusa *Reinhardtius hippoglossoides* (Walb.) (Pleuronectiformes, Pleuronectidae) Okhotskogo Morya [A Contribution to the Morphometric Characterization of the Pacific Black Halibut *Reinhardtius hippoglossoides* (Walb.) (Pleuronectiformes, Pleuronectidae) from the Sea of Okhotsk]. Vopr. Ikhtiol. 21: 157-160.
[In Russian]

The black halibut population structure is considered on the basis of correlation analysis of morphometric characters of the fish from different areas of the Sea of Okhotsk and from Pacific water off Paramushir I. Reliable differences are found between 4 groups: the group occurring on the Pacific side of Paramushir, 2 groups found off southwestern and western Kamchatka in the Sea of Okhotsk and the group occurring off eastern Sakhalin. Nine meristic characteristics (the number of gill rakers on epicerato- and hypobranchiales of the 1st gill arch on the orbital side, the number of rays in the dorsal, anal and both pectoral fins, and the number of body and caudal vertebrae) were studied in *R. hippoglossoides* (Walbaum) in 1974, 1978 and 1979. A correlation analysis made it possible to identify 2 groups of related meristic characteristics: the number of rays in the dorsal and anal fins; and the number of rays in pectoral fins. The other characteristics were not interrelated. Differences were found in the meristic characteristics of 4 Pacific black halibut groups: the group from the Pacific side of Paramushir Island, 2 groups encountered near the shores of southwestern and western Kamchatka Peninsula and 1 group inhabiting the sea near eastern Sakhalin Island. The 1st group differed significantly from the other groups. The greatest similarity was seen between the 2 groups from the Sea of Okhotsk near Kamchatka.

D'yakov, Y.P. 1981. Morphometric characterization of the Greenland halibut, *Reinhardtius hippoglossoides* (Pleuronectiformes, Pleuronectidae), from the Okhotsk Sea. J. Ichthyol. 21: 152-155.
[Translated from Russian: K Morfometricheskoj Kharakteristike Tikhookeanskogo Chernogo Paltusa Reinhardtius hippoglossoides (Walb.) (Pleuronectiformes,

Pleuronectidae) Okhotskogo Morya In: Vopr. Ikhtiol. 21 (1): 157-160]

This paper contains an analysis of the structure of the Greenland halibut *Reinhardtius hippoglossoides* on the basis of the variability of some morphometric indicators in different regions of the Sea of Okhotsk and in the Pacific waters off Paramushir Island.

D'yakov, Y.P. 1982. Plodovitost' chernogo pattusa *Reinhardtius hippoglossoides* (Walbaum) (Pleuronectidae) Beringova morya [Fecundity of the Bering Sea black halibut *Reinharditius hippoglossoides* (Walbaum) (Pleuronectidae)]. Vopr. Ikhtiol. 22 : 789-794.
[In Russian]

Data were presented on *R. hippoglossoides* absolute and relative fecundity and on the size of oocytes in females from various parts of the sea. The correlation between fish absolute fecundity and body mass was closer than that between absolute fecundity and age and body length. There were differences in the correlation between absolute fecundity and body mass in fish from the southeastern and central parts of the sea.

D'yakov, Y.P. 1982. The fecundity of the Greenland halibut, *Reinhardtius hippoglossoides* (Pleuronectidae), from the Bering Sea. J. Ichthyol. 22: 59-64.
[Translated from Russian: Plodovitost' chernogo pattusa Reinhardtius hippoglossoides (Walbuam) (Pleuronectidae) Beringova morya In: Vopr. Ikhtiol. 22(5): 789-794]

The reproductive capacity of the Greenland halibut, *R. hippoglossoides*, from the Bering Sea was studied. Data are presented on the absolute and relative fecundity and size of the oocytes of females from different regions of the sea. The link between fecundity and a number of biological indices of the fish is shown.

D'yakov, Y.P. 1984. Distribution and population structure of the Greenland halibut *Reinhardtius Hippoglossoides* in the Pacific Ocean. Biol. Morya 10: 57-60.
[In Russian]

The distribution of the Greenland halibut *R. hippoglossoides* in the northern Pacific Ocean is considered. The areas with the highest frequency of occurrence of mature fishes were determined. Most of the halibut populations were those with different genetic structure.

D'yakov, Y.P. 1984. Raspredelenie i populsatsionnya struktura kikookeaskogo chernogo paltusa [Distribution and population structure of Greenland halibut from the Pacific Ocean]. Biol. Morya 5: 57-60.
[In Russian]

Based on the analysis of the *Reinhardtius hippoglossoides* genogeographic survey it is concluded that there are not less than 6 populations of Greenland halibut in the North Pacific. The areas with the highest abundance of mature individuals have been detected. Most of the concentrations recorded differed in the genetic structure. Detailed tabulated data are provided on the allelic frequencies of 2 esterase isoforms and transferrin of the blood serum in different groups of Greenland halibut.

D'yakov, Y.P. 1987. Nekotorye osobennosti vosproizvodstva tikhookeanskogo chernogo paltusa *Reinhardtius hippoglossoides* [Some peculiarities in reproduction of Pacific black halibut *Reinhardtius hippoglossoides*]. Vopr. Ikhtiol. 27: 823-830.
[In Russian]

A study was made of reproductive structure of "Pacific black halibut" in the North Pacific in 1973-1983. An adverse effect of exploitation on the reproductive structure was observed to show itself in disturbed sex ratio, increase in the spawning stock recruitment and age re-distribution in population fecundity. To reduce fishery impact on reproductive structure of the Bering Sea halibut it is recommended that fishery should be performed in a wider bathymetric range at depth exceeding 700 m.

D'yakov, Y.P. 1987. Some reproductive features of the Pacific black halibut *Reinhardtius hippoglossoides*. Vopr. Ikhtiol. 27: 823-830.
[In Russian]

The reproductive structure of *R. hippoglossoides* was studied in the northern Pacific in 1973-1983. The data obtained made it possible to study the variability of some reproductive characteristics of its populations subject to commercial fishing of various degrees. Measures were recommended for reducing the negative effect of fishing on the reproductive structure of *R. hippoglossoides*.

D'yakov, Y.P. 1988. Some peculiarities of reproduction of Pacific black halibut, *Reinhardtius hippoglossoides*. J. Ichthyol. 28: 62-69.
[Translated from Russian: Nekotorye osobennosti vosproizvodstva tikhookeanskogo chernogo paltusa Reinhardtius hippoglossoides In: Vopr. Ikhtiol. 27(5): 823-830, 1987]

Studies were carried out on the reproductive structure of black halibut, *Reinhardtius hippoglossoides*, in the northern part of the Pacific Ocean during 1973-1983. The results show variation in some reproductive characteristics of populations subjected to various degrees of fishing. Recommendations are proposed for reducing the negative influence on the reproductive structure of the Bering Sea halibut.

D'yakov, Y.P. 1991. Population structure of Pacific black halibut, *Reinhardtius hippoglossoides*. J. Ichthyol. 31: 16-28.
[Translated from Russian: Populyatsionnaya struktura Tikhookeanskogo chernogo paltusa Reinhardtius hippoglossoides In: Vopr. Ikhtiol. 31 (3): 404-414]

The population structure of Pacific black halibut (Greenland halibut (*Reinhardtius hippoglossoides*)) was studied from 1976 to 1983. Electrophoretic analysis of some serum proteins revealed stable reproductively isolated groups of this species in the northern Pacific Ocean, and the boundaries of their areas of distribution were determined. A scheme of population structure was constructed, and influence of water circulation on the formation of populations of different type was demonstrated.

D'yakov, Y.P. 1991. Populyatsionnaya struktura Tikhookeanskogo chernogo paltusa *Reinhardtius hippoglossoides* [Population structure of the Pacific black halibut *Reinhardtius hippoglossoides*]. Vopr. Ikhtiol. 31: 404-414.
[In Russian]

Electrophoretic analysis of some blood serum proteins suggests the existence in the North Pacific of stable reproductively isolated black halibut (*Reinhardtius hippoglossoides*) groups. The direction and extent of passive egg and larvae migrations are factors determining the level of reproductive isolation. The intraspecific groups occurring within the zones of stable water circulations display a higher degree of genetic difference from those occurring in adjacent areas while the groups occurring in areas far apart geographically but connected by permanent currents are genetically related. The peculiarities of reproductive isolation permit the recognition of 2 population types.

D'yakov, Y.P., Koval, E.Z., and Bogdanov, L.V. 1981. Interspecies biochemical polymorphism and population structure of the Greenland halibut *Reinhardtius hippoglossoides* Walbaum (Pleuronectidae) in the Bering Sea and the Sea of Okhotsk. J. Ichthyol. 21: 29-35.

The intraspecies polymorphism of the Greenland halibut *Reinhardtius hippoglossoides*

Walbaum in terms of transferrin and two isoforms of blood serum esterase was studied. In terms of an index of genetic similarity, samples from 6 regions of the Bering Sea and Sea of Okhotsk were found to differ significantly from each other; this indicates that in these regions there exist independent populations. Significant differences were also found in the genetic pools of the halibut of the Bering Sea and the Sea of Okhotsk; this indicates reproductive isolation of the halibut living in these seas. Four-year-old halibuts living at different depths (greater and less than 25 m) in the Bering Sea differed significantly in the frequency of the genes of the Es sl locus, but the population significance of these differences has not yet been clarified.

Danke, L. 1981. German Democratic Republic research report for 1980. NAFO SCS documents 81/IX/26: 3 p.

Darby, C. 2001. An analysis of the effects of a change in trawl mesh size from 130 to 145 mm, within the Greenland halibut and by-catch species fisheries in Subarea 2 and Divisions 3KLMN. NAFO SCR documents 01/81: 8 p.

The effect of a change in mesh size from 130 mm to 145 mm is examined for the Greenland halibut (*Reinhardtius hippoglossoides*) fishery of NAFO Subarea 2 and Divisions 3 KLMNO. Changes in yield and spawning stock biomass per recruit, of the target and two of the main by-catch species American plaice (*Hippoglossoides platessoides*) and cod (*Gadus morhua*), are examined.

Darby, C. and Jørgensen, O.A. 2002. An extended survivors analysis (XSA) of the Greenland halibut in NAFO SA 0+1. NAFO SCR documents 02/68: 12 p.

An assessment of the Greenland halibut (*Reinhardtius hippoglossoides*) in NAFO Divisions 0+1 was carried out using Extended Survivors Analysis (XSA). Although the assessment results are considered to be provisional due to problems with the catch at age data and the short time series, the assessment is considered to reflect the dynamics of the stock. The results indicate that the stock increased during 1987-1990 and has since remained stable. The rate of exploitation has been relatively constant in recent years between 0.2-0.3.

Darby, C. and Jørgensen, O.A. 2003. An extended survivors analysis (XSA) of the Greenland halibut in NAFO Divisions 0 + 1. NAFO SCR documents 03/54: 18 p.

An assessment of the Greenland halibut (*Reinhardtius hippoglossoides*) in NAFO Divisions 0 + 1 was carried out using Extended Survivors Analysis (XSA). Although the assessment results are considered to be provisional due to problems with the catch at age data, the assessment is considered to reflect the dynamics of the stock. The results indicate that the stock increased during 1987-1990 and has since remained stable. The rate of exploitation has been increasing in recent years after a period of relatively stability.

Darby, C. and Mahe, J.C. 2000. An analysis of stock status of the Greenland halibut in Subarea 2 and Divisions 3KLMNO based on extended survivors analysis. NAFO SCR documents 00/53: 25 p.

The catch-at-age data for Greenland halibut (*Reinhardtius hippoglossoides*) in Subarea 2 and Divisions 3KLMNO were revised at the June 2000 meeting of the Scientific Council of the North Atlantic Fisheries Organization. A separable model has been used to examine the structure of the new data set and investigate trends in selection. Extended Survivors Analysis, calibrated using Canadian and European Union survey information, is used to assess the current status of the stock.

Darby, C., Bowering, W.R., and Mahe, J.C. 2002. Bullet points on the results of the assessment results for Greenland halibut in Subarea 2 and Divisions 3KLMNO. NAFO SCR documents 02/81: 4 p.

Uncertainties in the assessment of the assessment results for Greenland halibut (*Reinhardtius hippoglossoides*) in Subarea 2 and Divisions 3KLMNO are discussed with regard to their effect on the perception of the trends in the dynamics of the stock and the basis for management advice. The results of the assessment are contrasted with information from up to data survey information.

Darby, C., Bowering, W.R., and Mahe, J.C. 2003. An assessment of stock status of the Greenland halibut resource in NAFO Subarea 2 and Divisions 3KLMNO based on extended survivors analysis with short and medium-term projections of future stock development. NAFO SCR documents 03/64: 46 p.

Extended Survivors Analysis was applied to the commercial catch-at-age data for Greenland halibut (*Reinhardtius hippoglossoides*) in NAFO Subarea 2 and Div. 3KLMNO from 1975-2002 to assess the current status of the stock. The analysis was calibrated using Canadian and European Union research vessel survey data. The XSA model formulation was optimized in order to remove a retrospective bias in the estimated parameters. The exploitable stock biomass is estimated to be decreasing to the lowest level in the recorded time series, fishing mortality is increasing and is double the level of F sub(0.1). The trends in stock biomass and level of exploitation are consistent with all additional sources of information from the commercial fishery and surveys.

Darby, C., Healey, B., Mahe, J.C., and Bowering, W.R. 2004. Greenland halibut (*Reinhardtius hippoglossoides*) in Subarea 2 and Divisions 3KLMNO: an assessment of stock status based on upon extended survivors analysis, ADAPT, and ASPIC analyses, with stochastic projections of potential stock dynamics. NAFO SCR documents 04/55: 53 p.

The population size of Greenland Halibut in Subarea 2 and Divisions 3KLMNO was estimated using Extended Survivors Analysis (XSA). A sensitivity analysis of the XSA model formulation was conducted in order to examine the robustness of the estimated population trends. The diagnostics from a fit of the 2003 XSA formulation to the 2004 catch at age and survey data sets were reviewed. We conclude that the XSA formulation used in 2003 was still appropriate for fitting the model to the data and therefore retained the 2003 formulation. The XSA estimates are contrasted with estimates from an alternate age-disaggregated model (ADAPT), and a stock production model (ASPIC). All analyses indicate that in the recent period, stock biomass (5+) is estimated to be at the lowest level in the time series. Further, all of the methods indicate that fishing mortality increased steadily over 1995 to 2002, and that estimates of fishing mortality for 2003 represent a substantial increase over recent levels. Deterministic and stochastic projections of XSA results suggest that under the current rebuilding plan, the 5+ biomass will remain stable through 2005 at the current low level. By the year 2008, the 5+ biomass will slowly increase to reach the level estimated for 2003.

Davies, I.M., Barg, U., and Black, E. 2004. GESAMP initiative on environmental risk analysis for coastal aquaculture. ICES CM 2004/V:05: 25 p.

Dawe, E.G., Bowering, W.R., and Joy, J.B. 1998. Predominance of squid (*Gonatus spp.*) in the diet of Greenland halibut (*Reinhardtius hippoglossoides*) on the deep slope of the northeast Newfoundland continental shelf. Fish. Res. 36: 267-273.

The feeding ecology of Greenland halibut (*Reinhardtius hippoglossoides*) on the deep slope of the northeast Newfoundland continental shelf was investigated based on stomach analysis. Stomach samples were collected from the spring 1992 Canadian bottom trawl fishery at depths of 1000-1250 m. The squid, *Gonatus* spp., predominated in the diet, representing the first known instance of reliance of Greenland halibut upon this bathypelagic squid as prey in Canadian waters. A change from predation primarily upon pelagic prey, reported in earlier studies, may be related to annual variability in abundance and distribution of both Greenland halibut and its principal pelagic fish prey species, capelin (*Mallotus villosus*). Seasonal effects may account for the absence of epipelagic, juvenile *Gonatus* spp. from the diet. There was a linear size relationship in observed predation which may reflect a common size-related depth distribution pattern between predator and prey or, more likely, prey selectivity. At larger sizes, Greenland halibut switched from *Gonatus* spp. to groundfish as its principal prey. The importance of *Gonatus* spp. in the deep continental slope trophic web is reviewed.

Dawe, E.G., Bowering, W.R., and Joy, J.B. 1999. Predominance of squid (*Gonatus spp.*) in the diet of Greenland halibut (*Reinhardtius hippoglossoides)* on the deep slope of the northeast Newfoundland continental shelf. *In* Ecology, fisheries and management of Greenland halibut (*Reinhardtius hippoglossoides* (Walbaum)) in the Canadian Northwest Atlantic. *Edited by* W.R.Bowering. University of Bergen (Norway). Thesis (Ph.D.) University of Bergen, Bergen, Norway. 6 p.

The feeding ecology of Greenland halibut (*Reinhardtius hippoglossoides*) on the deep slope of the northeast Newfoundland continental shelf was investigated based on stomach analysis. Stomach samples were collected from the spring 1992 Canadian bottom trawl fishery at depths of 1000-1250 m. The squid, *Gonatus* spp., predominated in the diet, representing the first known instance of reliance of Greenland halibut upon this bathypelagic squid as prey in Canadian waters. A change from predation primarily upon pelagic prey, reported in earlier studies, may be related to annual variability in abundance and distribution of both Greenland halibut and its principal pelagic fish prey species, capelin (*Mallotus villosus*). Seasonal effects may account for the absence of epipelagic, juvenile *Gonatus* spp. from the diet. There was a linear size relationship in observed predation which may reflect a common size-related depth distribution pattern between predator and prey or, more likely, prey selectivity. At larger sizes, Greenland halibut switched from *Gonatus* spp. to groundfish as its principal prey. The importance of *Gonatus* spp. in the deep continental slope trophic web is reviewed.

de Cárdenas, E. 1996. Spanish research report for 1995. NAFO SCS documents 96/14: 2 p.

de Cárdenas, E. 1996. The females ratio by length as an indicator of sexual differences in mortality of Greenland halibut (*Reinhardtius hippoglossoides*) at ages 8+. NAFO SCR documents 96/35: 10 p.

This paper analyses the female ratio by length for the period 1992-94 in the Greenland halibut (*Reinhardtius hippoglossoides*) fishery in the NAFO Regulatory Area. Female ratio by length is very consistent in the 3 year period, increasing dramatically from approximately 50 cm upwards until reaching over 90% at 70 cm. In order to explain this phenomenon, growth and mortality by sex were analysed using data from 1993. The main conclusion is that mortality is the factor with the greatest influence on it. Other conclusions are that females grow slightly faster than males of over 7 years of age, and that age 7 appears to be fully recruited to the fishery.

de Cárdenas, E. 1997. Influence of latitude on the catchability of Greenland halibut. NAFO SCR documents 97/34: 6 p.

The present paper compares the proportions of Greenland halibut (*Reinhardtius hippoglossoides*) females by length in the catch of the NAFO Regulatory Area and Svalbard, which is to the north. An increase in the catchability of males of over 5 years is detected in Svalbard which does not appear in the NAFO fishery. This difference gives rise to different sex ratios in the catch of both areas. A trend for the catchability of males to increase with latitude seems to exist, the causes of which remain unexplained.

de Cárdenas, E. and Motos, L. 1997. Influence of post-escapement mortality in the yield of a Greenland halibut trawl fishery. NAFO SCR documents 97/76: 4 p.

This paper tries to assess the potential effects of post-escapement mortality on the results of a yield per recruit analysis for Greenland halibut(*Reinhardtius hippoglossoides*) in Subareas 2 and 3. In order to assess the effect of post-escapement mortality on the yields of Greenland halibut in a trawl fishery, a simple model was constructed. The model simulates the effect of different levels of post-escapement mortality on the long term yield. Results show that the problem of post-escapement mortality can be important for the management of this and other similar fisheries. The consequence of not accounting for post-escapement mortality in the deaths when managing a fishery at a certain level is that overfishing occurs.

de Cárdenas, E. and Motos, L. 1997. Yield per recruit for Greenland halibut in Subareas 2 and 3, considering a dome shaped exploitation pattern and differences in natural mortality (M) between sexes. NAFO SCR documents 97/33 (Rev.): 6 p.

The aim of this work is to simulate the long term changes in yields and spawning biomass per 1000 recruits which a mesh size change to 205 mm would bring about if there were sexual differences in natural mortality, and if the trawl exploitation pattern were dome shaped. The length at 50% maturity of the 205 mm mesh size gear is 60 cm as derived from the selection factor for Greenland halibut, *Reinhardtius hippoglossoides*. With respect to the problem of escapement mortality, it is generally assumed that cod-end escapement mortality is insignificant and that all escapees survive and grow. Recent work suggests that this may not always be the case. Due to the small long term gains both in spawning biomass and in yield which the model for the change in mesh size to 205 mm shows, the authors advise caution in making this change.

de Cárdenas, E., Junquera, S., and Vazquez, A. 1993. Abundance indices of Greenland halibut in deepwater fishing zones of NAFO Divisions 3LMN. NAFO SCR documents 93/61: 8 p.

Since 1990 a deepwater fishery of Greenland halibut has been developed in the boundary of Divisions 3L and 3M, extended to the North of Division 3N in 1992. The main participants in this fishery are Spain and Portugal. A description of this fishery is found in Junquera et al. (1992). The Spanish fleet is composed by bottom trawlers that fish from depths of 800 m onwards. Catch rates are of the same level as in other areas where Greenland halibut were traditionally exploited (Brodie, 1991). The fishing activity has been monitored by observers on board since the onset of this fishery. Eight observers stayed on board these commercial vessels in 1990, 23 in 1990 and 30 in 1992. They provided a great amount of information on fishing areas, length distribution, catches and effort which would allow us to get quite a clear picture about the trends of this species in the area. The fleet in 1990 was mainly large trawlers, but smaller vessels were incorporated with time. This heterogeneity of the fleet and the differences in survey intensity at different seasons and years hampered a direct interpretation of the raw information on catch and effort to calculate indices accounting for seasonality or long-trends in catch rates Junquera et al., 1992). Following a recommendation of the NAFO Scientific Council in 1992 (Anon., 1992), the standardization of the catch rates in the whole available time series of data from the commercial fishery is undertaken in this paper. It allowed us to obtain comparable time series of catch rates, which can be considered as fishery related abundance indices because this is a directed fishery for Greenland halibut.
Notes: Not to be cited without prior reference to authors

de Cárdenas, E., Junquera, S., and Vazquez, A. 1995. Spanish resesarch report for 1994. NAFO SCS documents 95/15: 13 p.

de Cárdenas, E., Casas, J.M., Alpoim, R., and Murua, H. 1996. Preliminary results of the European long-line survey in the NAFO regulatory area. NAFO SCR documents 96/34: 6 p.

One of the uncertainties at the time of assessing the state of the Greenland halibut stock in the West Atlantic was the lack of knowledge on the batimetric limits of this species. The commercial fishery, which had surpassed the depths of the research surveys at 1800 m depth, continued to find exploitable concentrations of this species. With the aim of finding these limited and improving knowledge of the batimetric distribution of this species, Spain and Portugal, financed by the E.U., proposed a long-lie survey which would reach 3000 m depth.

de Cárdenas, E., Ávila de Melo, A., Iglesias, S., and Saborido, F. 1997. Selectivity of 130 mm mesh size in deep sea bottom trawl fishery in NAFO Regulatory Area. Northwest Atl. Fish. Organ. Sci. Counc. Stud. 30: 21-25.

In February 1995 the European Union carried out a selectivity survey on board a Spanish commercial trawler, using the cod-end-cover method. The objective was to study the selectivity of 130 mm mesh size for the deep sea trawl fisheries in the NAFO Regulatory Area. One hour and four hour hauls were carried out and results obtained for Greenland halibut (*Reinhardtius hippoglossoides*), American plaice (*Hippoglossoides platessoides*), roughhead grenadier (*Macrourus berglax*), and threebeard rockling (*Gaidropsarus ensis*). For the two flatfish species, the proportion of retention increased with the duration of the haul. This increase reflected in a decrease of the corresponding selection factor. It also varied with the size of the fish. The selection factor was greater in smaller individuals, and this induced an asymetry in the selectivity curve. For the groundfish species, data were enough only to fit the four hour selectivity curves, which appeared more symmetrical than the flatfish ones.

de Cárdenas, E., Motos, L., and Junquera, S. 1998. Expected trends on the 2J3KLMNO Greenland halibut in status quo conditions. NAFO SCR documents 98/63: 5 p.

The aim of this paper is to anticipate the trend in stock biomass, spawning stock biomass, and catches of the Greenland halibut (*Reinhardtius hippoglossoides)* stock in NAFO Divisions 2J3KLMNO in status quo conditions. In order to get estimates of the trends a simple model has been developed based on survey indices of numbers at age.

de Cárdenas, E., Motos, L., and Junquera, S. 1999. A simple method to project catches in the absence of VPA. NAFO SCR documents 99/2: 10 p.

The information available about exploited fish stocks is often restricted to catches and an abundance index of numbers-at-age from direct surveys of commercial data. In these cases, analytical assessment is not possible. This paper presents a simple method to project catches and to define biological reference points for stocks where information is restricted to total catch in weight, mean weight at age, and at least one abundance index by age. This method permits the estimate of reference points defined by the levels of effort maximising yield-per-recruit function as well as the 0.1 level for this function. The whole family of Biological Reference Points would be defined if: a) the abundance index were representative of the spawning biomass level and b) a reliable stock recruitment relationship could be defined.

de Groot, S.J. 1970. Some notes on an ambivalent behaviour of the Greenland halibut *Reinhardtius hippoglossoides* (Walb.) Pisces: Pleuronectiformes. J. Fish Biol. 2: 275-

279.

The ambivalent behaviour of the Greenland halibut with respect to its swimming position is discussed. The conclusion is that, when swimming close to the bottom, it swims the way all flatfishes do, viz. horizontally; when it swims freely, however, it adopts a vertical position.

Declerck, D. and Vyncke, W. 1975. Determination of the condition of Greenland halibut (*Rheinhardtius hippoglossoides* Walb) by the refractive index of the expressible muscle fluid. Chem. Mikrobiol. Technol. Lebensm. 4: 25-28.

The determination of the refractive index of the expressible muscle fluid of Greenland halibut by means of a hand refractometer appeared to be the most convenient way to determine the biological condition and classify the fish according to texture. A small hand press was used. Temp should be kept between 18 and 22 [degree] C. The amount of fish and the pressing time have no marked influence on the refractive index and the fish sample can be taken on any part of the fish without great loss of reliability.

deGraaf, D.A., Chaput, G.J., Sandeman, M.R., Buchanan, R.A., and Total Eastcan Explorations Limited 1980. The food habits of cod (*Gadus morhua*) and turbot (*Rheinhardtius hippoglossoides*) along the Labrador coast, summer 1979. Offshore Labrador Biological Studies Program. 107 p.

del Rio, J.L. and Lorenzo, L. 2004. Results of the Spanish experimental fishing in NAFO Subarea 1. NAFO SCR documents 04/23: 17 p.

Experimental fishing was carried out with a commercial Spanish vessel from October to December of the year 2003 in the Subarea 1. The main objective of the experimental fishing was to search for cephalopod species concentrations inside the territorial waters of Greenland. During the experimental fishing a scientific observer stayed on board to collect effort data, catches and yields by haul and Division, strata and gear. The observer carried out length distributions samplings of the following species: *Pandalus borealis, Sebastes* spp., *Hippoglossoides platessoides, Gadus morhua* and *Macrourus berglax*. Biological samplings of *Reinhardtius hippoglossoides, Hippoglossoides platessoides, Gadus morhua* and *Gadus ogac* were also carried out. Greenland halibut was the main species caught and the cephalopods, target species, have not been found in the experimental fishing.

del Rio, J.L., Duran Munoz, P., Vazquez, A., Murua, H., Román, E., and Gonzalez, F. 2002. Spanish research report for 2001. NAFO SCS documents 02/7: 26 p.

Dey, A.C. 1982. Comparison of the properties of phosphoglucomutase from muscle of turbot (*Reinhardtius hippoglossoides*, Greenland halibut) and witch flounder (*Glyptocephalus cynoglossus*) from the Northwest Atlantic and the Gulf of St. Lawrence. Comp. Biochem. Physiol. B 72B: 249-254.

Phosphoglucomutase from muscle of turbot and witch has been purified and the properties studied from two regions of the Northwest Atlantic and the Gulf of St. Lawrence. The enzyme, purified 157 fold from turbot and 164 fold from witch had specific activites of 596 and 475 U/mg/min respectively. The M.W. and pH optimum of the enzyme from both species were 63,500 and 7,500; and 63,000 and 7800 for the Northwest Atlantic and the Gulf samples respectively. The amino acid contents and responses towards different inhibitory agents were different for the enzyme from the Gulf than the Northwest Atlantic samples.

Diakov, Y.P. 1998. Population structure of the Pacific black halibut *Reinhardtius matsuurae* Jordan et Snyder. J. Sea Res. 40: 109-116.

A blood serum electrophoresis study of black halibut (*Reinhardtius matsuurae* Jordan et Snyder) in the North Pacific revealed polymorphic protein systems of esterases (Est-1, Est-2) and transferrin (Tf). Comparison of genetic similarity among black halibut from different locations of the northern Pacific Ocean showed that groups inhabiting areas with stable water circulation were genetically more different than groups inhabiting geographically distant waters that were connected by sea currents. It is concluded that black halibut in the North Pacific consists of two types of metapopulations. The first type comprises populations inhabiting waters with a stable water circulation which entrains the pelagic eggs and larvae. The other type comprises an aggregate of local populations connected to a central population through water currents that transport the pelagic eggs and larvae.

Dolgov, A.V. 2000. Feeding and food consumption by the Barents Sea predatory fishes in the 1980-90s. ICES CM 2000/Q:02: 17 p.

Data from the Russian-Norwegian data base were used to study food composition of the most numerous Barents Sea fishes cod (*Gadus morhua*) haddock (*Melanogrammus aeglefinus*), Greenland halibut (*Reinhardtius hippoglossoides*), long rough dab (*Hippoglossoides platessoides*), thorny and other skates (*Raja*), redfishes (*Sebastes*), saithe (*Pollachius virens*) in the 1980-90s. Length composition of commercial prey species and changes in predator diet depending on their length (age) are analysed. Possible values of total food consumption by these species are estimated and the impact of these predators on the stock status of commercial species is described. Biomass of food consumed by fish is compared to that consumed by other top predators (sea mammals).

Dopazo, C.P., Bandin, I., López-Vazquez, C., Lamas, J., Noya, M., and Barja, J.L. 2002. Isolation of viral hemorrhagic septicemia virus from Greenland halibut *Reinhardtius hippoglossoides* caught at the Flemish Cap. Dis. Aquat. Org. 50: 171-179.

Viral hemorrhagic septicemia virus (VHSV) was isolated from apparently healthy Greenland halibut *Reinhardtius hippoglossoides* caught in the Flemish Cap, a deep fishing ground in the North Atlantic Ocean in international waters near Newfoundland. The identity of the virus was confirmed by electron microscopy, immunodot, seroneutralization and reverse transcriptase-polymerase chain reaction. In the serology assays, all isolates reacted in the immunodot assay with a polyclonal antiserum against the European VHSV Type Strain F1, and were neutralized by the same antiserum, although most of the strains showed low or moderate neutralization titers. None of the isolates were detected by immunofluorescence using a specific monoclonal antibody against a nucleo-capsid-related protein of VHSV F1. This is the first report of VHSV isolated from wild Greenland halibut, which represents a new host species for the virus, and it is also the first evidence of VHSV in a location close to the Atlantic coast of North America. This isolation indicates that VHSV is more widely distributed than has been thought, and appears to support a marine origin of this virus.

Dornheim, H. 1996. Der Internationale Rat fuer Meeresforschung (ICES) empfiehlt Fangmengen fuer 1997 [The International Council for the Exploration of the Sea (ICES) gives advice on TACs for 1997]. Inf. Fischwirtsch. 43: 117-120.
[In German, English summary]

Based on the report of the most recent meeting of the ICES Advisory Committee on Fishery Management (ACFM), May 1996, brief up-to-date information is given on the status of the fish stocks utilized by the German fleet and the relevant advice on TACs to be fished in 1997.

Dornheim, H. 1996. Perspektiven fuer die wichtigsten von der deutschen Fischerei genutzten Bestaende fuer 1996 [Outlook for 1996 on the most important fish stocks utilized by the German fishery]. Inf. Fischwirtsch. 43: 15-23.
[In German, English summary]

This article informs about the current status and development of fish stocks which are of commercial importance for all branches of the German fisheries in the entire North Atlantic. The information is based to a large extent on the reports of the Advisory Committee on Fishery Management (ACFM) of the International Council of the Sea (ICES) and in close connection with the results of scientific investigations of different institutes in Europe dealing with fish including the Institute for Sea Fisheries in Hamburg.

Dudnik, Y.I. and Dolganov, V.N. 1992. Distribution and resources of fish on the continental slope of the Sea of Okhotsk and Kuril Islands in summer of 1989. Vopr. Ikhtiol. 32: 83-98.
[In Russian]

Two hundred and eighty-eight benthic trawling stations were conducted during May-September of 1989 on the continental slope of the Sea of Okhotsk and slope of northern Kuril Islands at the depths of 300-2000 m. One hundred and fourteen of benthic and benthopelagic species were identified. *Coryphaenoides pectoralis, Reinhardtius hippoglossoides, Coryphaenoides cinereus, Lycodes soldatovi, Bothyraja parmifera, Lycogramma brunea, Coryphaenoides acrolepsis; Laemonema longipes, Lycogramma soldatovi, Bathyraja aleutica, Lumpenella longirostris, Bathyraja matsubarai, Antimora microlepis, Elassodiscus tremebundus, Malacocottus zonurus,* and *Sebastolobus macrochir* predominated in catches (93%). Data are presented on the distribution and biological features of the dominant species. The commercial potential of the fish is considered. Differences in the role of the continental slope and the Kuril Island slopes in the life cycles of grenadiers and *Laemonema* longipes were demonstrated.

Duran, P. and Paz, X. 1997. Witch flounder (*Glyptocephalus cynoglossus)* in the Spanish fishery in NAFO Regulatory Area (Divisions 3LM and 3NO) 1991-94. NAFO SCR documents 97/24: 16 p.

The by-catch of witch flounder (*Glyptocephalus cynoglossus*) in the Spanish fishery in the NAFO Regulatory Area was analyzed during the period 1991 to 1994. A total of 32 483 hauls were sampled. Data from 3NO Spanish bottom trawl surveys were also included in the analysis. Total catch was estimated for this period, showing high variability both by division and by year. The maximum was reached in 1994 in NAFO Div. 3NO. The yield shows seasonality. It was greater in March-April. In the period 1992-96, the annual yield shows an increase. The length distribution and the length/weight relationships were obtained in a deep range of 1500m. The length range was 24-58in males and 26-62in females. The mean length decreased throughout the period analysed, and it was higher in the large vessel catches. The individuals were also larger in 3M division. The sex ratio showed seasonal variation in the large vessel catches, while any clear trend appears in the small ones. In addition to Greenland halibut (*Reinhardtius hippoglossoides*) which was the target species, the main accompanying species of the witch flounder catches were: redfish (*Sebastes*) grenadiers (*Macrouridae*) skate (*Rajidae*) and occasionally American plaice (*Hippoglossoides platessoides*).

Duran, P. and Paz, X. 2000. Witch flounder (*Glyptocephalus cynoglossus*) in the Spanish deep sea fishery (NAFO Divisions 3LMINO), 1991-94. Northwest Atl. Fish. Organ. Sci. Counc. Stud. 33: 117-127.

The by-catch of witch flounder (*Glyptocephalus cynoglossus*) was studied in the Spanish deep-sea fishery for Greenland halibut, which developed in the NAFO Regulatory Area in Dev. 3LMNO over the period 1991-94. A total of 32,483 hauls were sampled. Some data from the Div. 3NO Spanish bottom trawl survey in 1995 and 1996 were also included in this study. Witch flounder yield was estimated for this period. The yield showed an annual seasonality where yield was greater in spring. Through the period 1992-96, the overall annual yield showed a general increase. The length frequency and the length/weight relationship were obtained from samplings performed at depths ranging from 800 m to 1500 m. The length range of the individuals was 26-60 cm in males and 22-72 cm in females. The mean length decreased throughout the period analyzed, and was higher in the large vessel catches. The individuals were also larger in Div. 3M. The sex ratio showed seasonal variation in the large vessel catches, while no clear trend appeared in the small vessels. In addition to Greenland halibut, which was the target species, the main fish species accompanying the witch flounder catches were redfish, grenadiers, skate and American plaice as incidental catch.

Duran, P., Paz, J., and Ramilo, L. 1996. By-catch species in the Greenland halibut Spanish (NAFO Divisions 3LM and 3NO): 1991-1994. NAFO SCR documents 96/12: 36 p.

The specific composition of by-catch was studies: 17 species, their presence calculated by depth strata, month and Division, and variations in monthly yield by division in the Spanish Greenland halibut fishery, developed in the NAFO regulated area for the period 1991-1994. Two groups of species were identified depending on the importance of their presence in catches: the more and less frequent species. The more frequent species were considered those with a value of above 5kg/h annual yield, i.e. skate, roundnose grenadier and roughhead grenadier, American plaice, witch flounder and redfish. Analyzing the data on a monthly basis, however, reveals the presence of higher values of yield than other species. Some species show a stational pattern, such as grenadiers, skate and American plaice, particularly in Division 3N. On the other hand, other species have increased yields in recent years. In this fishery, the characteristic species of the demersal fisheries (skate, American plaice) showed a wider bathymetric distribution than that considered typical in each case. The transfer of effort southwards (Divs. 3NO) in recent years, mainly in the case of small vessels, has meant variation in the composition and relative abundance of by-catch in this fleet.

Duran, P., Paz, J., and Ramilo, L. 1997. By-catch in the Spanish Greenland halibut fishery (NAFO Divisions 3LMNO): 1991-94. Northwest Atl. Fish. Organ. Sci. Counc. Stud. 30: 1-30.

The species composition of by-catch was studied in the Spanish Greenland halibut (*Reinhardtius hippoglossoides)* fishery, developed in the NAFO Regulatory Area in Divs. 3L, 3M and 3NO, for the period 1991-94. Of the 17 species occurring in the catches, two groups were identified as the more and less frequent species. The more frequent species, with an annual yield of about 5 kg/hr were roughhead grenadier, *Macrourus berglax*, roundnose grenadier, *Coryphaenoides rupestris*, skate, *Raja* sp., American plaice, *Hippoglossoides platessoides*, redfish, *Sebastes* sp., witch flounder *Glyptocephalus cynoglossus*, and blue antimora, *Antimora rostrata*. Analyzing the data on a monthly basis revealed some species such as grenadiers, skate and America plaice, particularly in Div. 3N, did not change much while other species had increased yields in recent years. The characteristic species of the demersal fisheries (skate, American plaice) showed a wide bathymetric distribution. The transfer of effort southwards to Div. 3NO in recent years, mainly in the case of small vessels, has meant variation in the composition and relative abundance of by-catch in this fleet. The proportion of each by-catch species was highly variable. Skate, American plaice, with flounder, and grenadiers were caught most frequently in both fleets. In the large vessels, blue antimora, redfish and roundnose grenadier were more frequent than in small vessels. The length distribution in the discarded proportion was analyzed for the two grenadiers, skate and blue antimora. In general, the length distribution of the proportion discarded showed a wide range.

Duran, P., Paz, X., and Cardenas, E.D. 1998. Results from the 98 Spanish bottom trawl survey in the NAFO Regulatory Area for Divisions 3NO. NAFO SCR documents 98/48: 20 p.

A stratified-random bottom trawl survey was performed in NAFO Regulatory Area (Divisions 3NO) during the 6th to 28th May, 1998. A total of 124 successful fishing nets were completed, 101 in Div 3N and 23 in Div 3O. At touchdown of the net a standard 30 minutes tow started at a mean speed of 3 knots. Trawls with net damage were excluded from analysis. The catches of the 5 species considered: American plaice (*Hippoglossoides platessoides*), yellowtail flounder (*Pleuronectes ferrugineus*), Greenland halibut (*Reinhardtius hippoglossoides*), witch flounder (*Glyptocephalus cynoglossus*) and northern cod (*Gadus morhua)* are increasing this year and their value indices estimates are greater.

Duthie, A. and Marsden, A. 1995. Canadian experience: Deep water fishing gillnetting in the Northwest Atlantic Ocean. *In* Deep-water fisheries of the North Atlantic oceanic slope. *Edited by* A.G.Hopper. Kluwer Academic Publishers, Dordrecht, The Netherlands. pp. 397-405.

In 1993, commercial inshore gillnet vessels continued exploratory fisheries for Greenland halibut in the north west Atlantic, off the coasts of Newfoundland and Labrador. Catch rates doubled those of fisheries conducted in 1992; five vessels fishing to maximum depths landed 518,790 kg of Greenland halibut and 4,300 kg of roughhead grenadier. In the 1992 season fishing effort, fishing depths and fishing gear for 22 inshore gillnet vessels in the length range 16.5 to 19.5 m. were monitored in the north west Atlantic. Greenland halibut (*Reinhardtius hippoglossoides*) catches were analysed to identify catch rates, the average fish size, by-catch quantities and the mesh size versus size of fish caught. Recommendations included the expansion of deep-water gillnet fishing, detailed stock assessment studies, analysis of fishing pressure impact, and marketing and utilisation of the significant by-catch of roughhead grenadier.

Dwyer, K.S. and Bowering, W.R. 2003. Greenland halibut (*Reinhardtius hippoglossoides*) in NAFO Subarea 2 and Divisions 3KLMNO: stock trends based on annual Canadian research vessel survey results during 1978-2002. NAFO SCR documents 03/51: 57 p.

Greenland halibut (*Reinhardtius hippoglossoides*) are widely distributed throughout the Labrador-eastern Newfoundland area. During the late 1970s and most of the 1980s they were found in relatively high abundance along the deep slopes of the continental shelf particularly in Division 2G. They were similarly plentiful in the deep channels running between the fishing banks especially in Div. 2H, 2J and 3K. By 1991 distribution in the northern areas was greatly reduced and most of the resource was located in Div. 3K and along the north slope of Div. 3L and to some degree Div. 3N. By 1996-2001 distribution to some areas of historically high abundance off southern and central Labrador as well as northeast Newfoundland again began to occur. In Div. 2J and 3K where most of the Greenland halibut resource resides the stock biomass was relatively stable until the mid-1980s after which it declined substantially to reach an all time low in the early-1990s largely precipitated by the disappearance of older fish from the population. From about 1995 the stock began to increase and continued to improve to 1999 based upon several good successive year-classes particularly those of 1993-1995. However, since 1999, the stock declined again and by 2002, it reached its lowest point since the early-1990s. There has been no observed improvement in the spawning stock biomass estimates for more than a decade. This paper updates the Canadian research vessel survey results for 2002 and introduces figures and tables of stratified mean numbers (000s) and weights (kg) per tow with associated confidence intervals, as recommended in NAFO Sci. Counc. Rep.,

2002. These showed similar trends as the swept area estimates, but because they are standardised, they are more comparable since they remove much of the bias due to varying survey coverage.

Dwyer, K.S. and Healey, B.P. 2005. Greenland halibut (*Reinhardtius hippoglossoides*) in NAFO Subarea 2 and Divisions 3KLMNO: stock trends based on annual Canadian research vessel survey results during 1978-2004. NAFO SCR documents 57 p.

Greenland halibut are widely distributed throughout the Labrador-eastern Newfoundland area. During the late 1970s and most of the 1980s they were found in relatively high abundance along the deep slopes of the continental shelf, particularly in Div. 2G. They were similarly plentiful in the deep channels running between the fishing banks especially in Div. 2H, 2J and 3K. By 1991 distribution in the northern areas was greatly reduced and most of the resource was located in Division 3K; however since 1999 the biomass has declined by 50% in Div. 3K. In Div. 2J and 3K where most of the Greenland halibut resource presently resides, the stock biomass was relatively stable until the mid- 1980s after which it declined substantially to reach an all time low in the early 1990s largely precipitated by the disappearance of older fish from the population. From about 1995 the stock began to increase and continued to improve to 1999 based upon several strong, successive year-classes particularly those of 1993-95. However, since 1999, the stock declined again and by 2002, it reached its lowest point since the early 1990s. Since then, although there has been variation of stock size within Divisions, the overall stock has not increased, remaining at a low level. Strong recruitment predicted in the 1990s has been overestimated, overexploited or both, and has not contributed growth to the stock as older, larger fish. Although estimates of spawning stock biomass are largely unknown, the annual biomass estimates of Greenland halibut >70 cm in Div. 2J+3K have been near zero for more than a decade. This paper updates the Canadian research vessel survey results for 2004, and compares these results to prior observations. Despite reduced coverage in the 2004 survey, it is still obvious that this stock is showing no signs of improvement.

Dwyer, K.S. and Morgan, M.J. 2004. A stock status update of American plaice in NAFO Divisions 3LNO. NAFO SCR documents 04/47: 24 p.

Catches from the Greenland halibut (*Reinhardtius hippoglossoides*) stock were generally in the range of 40,000 to 50,000 tons per year throughout the 1970s and 1980s, before declining to low levels in the early-1990s. There has been no directed fishing on this stock since 1993. The TACs in 1995 to 2004 have been set at 0. In 2003, catch estimates ranged from 6,855 to 10,599 tons (with a mean of 8.727 tons). As in recent years, catches in 2003 were mainly in the NAFO Regulatory Area (NRA) and as by catch in the Canadian yellowtail flounder (Limanda ferruginea) fishery. The Canadian spring surveys show a large decline in abundance and biomass from the mid to late 1980's with current biomass being only 22% of that of the mid 1980's. The fall survey has also shown large declines and the biomass is only 32% of that of 1990.

Dwyer, K.S., Bowering, W.R., and Healey, B.P. 2004. Greenland halibut (*Reinhardtius hippoglossoides*) in NAFO Subarea 2 and Divisions 3KLMNO: stock trends based on annual Canadian research vessel survey results during 1978-2003. NAFO SCR documents 04/48: 62 p.

Greenland halibut (*Reinhardtius hippoglossoides*) are widely distributed throughout the Labrador-eastern Newfoundland area. During the late 1970s and most of the 1980s they were found in relatively high abundance along the deep slopes of the continental shelf, particularly in Division 2G. They were similarly plentiful in the deep channels running between the fishing banks especially in Div. 2H, 2J and 3K. By 1991 distribution in the northern areas was greatly reduced and most of the resource was located in Div. 3K;

however in the past two years the biomass has declined by 50% in Div. 3K. In Div. 2J and 3K where most of the Greenland halibut resource presently resides, the stock biomass was relatively stable until the mid-1980s after which it declined substantially to reach an all time low in the early-1990s largely precipitated by the disappearance of older fish from the population. From about 1995 the stock began to increase and continued to improve to 1999 based upon several good successive year-classes particularly those of 1993-1995. However, since 1999, the stock declined again and by 2002, it reached its lowest point since the early 1990s. Biomass estimates increased in some Div. slightly, possible due to new recruitment, but remained low in 2003. Although estimates of spawning stock biomass are largely unknown, the annual biomass estimates of Greenland halibut > 70 cm in Div. 2J 3K have been near zero for more than a decade. This paper updates the Canadian research vessel survey results for 2003.

Emberley, B.J. 1969. The incidence of bruising and the effect of bleeding on Greenland turbot (caught by gill netting). Canada. Department of Fisheries and Oceans. Newfoundland Region, St. John's, Nfld. 5 p.

Engås, A., Jørgensen, T., and Angelsen, K.K. 2000. Effects on catch rates of baiting gillnets. Fish. Res. 45: 265-270.

In this paper we investigate whether the use of bait on gillnets increases catch rates. Experiments were conducted during ordinary fishing in Norwegian waters for three different species; cod, ling and Greenland halibut. Each third gillnet of a fleet consisting of 24 nets was baited with mackerel. Catch rate of this experimental fleet was compared with a similar fleet without bait. The baited nets gave a significantly higher catch for all three species, with an increase of 61%, 23% and 36% for cod, ling and Greenland halibut, respectively. On the baited fleet, the catch rates were highest on the baited nets. For cod and saithe the non-baited nets on a baited fleet had higher catch rates than the (non-baited) nets of the control fleet.

Engelstoft, J. and Jørgensen, O.A. 1999. Biomass and abundance of demersal fish stocks off West Greenland estimated from the Greenland shrimp survey 1988-1998. NAFO SCR documents 99/27: 19 p.

Since 1988 the Greenland Institute of Natural Resources has annually conducted a bottom trawl survey covering NAFO Div. 1A-1B at depths from 0-600 m. The main purpose of the survey is to evaluate the biomass and abundance of northern shrimp (*Pandalus borealis*). Data on most fish species have been recorded. In 1998 233 tows were made. This paper presents an update of biomass and abundance estimates together with length frequencies of northern cod (*Gadus morhua*), Greenland halibut (*Reinhardtius hippoglossoides*), redfish (*Sebastes* spp) and other ecologically important species from the survey area.

Engelstoft, J.J. 1996. By-catches in the shrimp fishery at West Greenland. NAFO SCR documents 96/36: 11 p.

A catch of about 50 000 tons shrimp (*Pandalus borealis*) has been taken annually at West Greenland since 1986. Large quantities of juvenile redfish (*Sebastes*). Greenland halibut (*Reinhardtius hippoglossoides)* and other groundfish are being caught in the small-mesh shrimp trawls. Trawl hauls for shrimp by a research vessel are used in order to estimate the by-catch in 1994 of redfish, Greenland halibut and other important species in the fishery for shrimp in NAFO Division 1 south of 70 degree N. Comparisons are made of these by-catch estimates with those stated by a commercial Greenland shrimp trawler as well as with those obtained from previous investigations in the area. The legislation on shrimp fishery in Greenland command a vessel to leave an area, if the by-catch per haul exceeds 10%. An annual by-catch of about 180 millions of redfish and 160-170 thousands

of cod suggest a causality between the by-catch in shrimp fishery and the recruitment failure of these stocks at West Greenland.

Engelstoft, J.J. and Jørgensen, O. 1997. Biomass and abundance of demersal fish stocks off West Greenland estimated from the Greenland trawl fishery, 1988-1996. NAFO SCR documents 97/39: 17 p.

Since 1988, the Greenland Institute of Natural Resources has, annually, conducted a bottom trawl survey off West Greenland. The main purpose of the survey is to evaluate the biomass and abundance of northern shrimp (*Pandalus borealis*), but data on most fish species has been recorded. This paper presents biomass and abundance estimates together with length frequencies of cod *Gadus morhua*, Greenland halibut *Reinhardtius hippoglossoides*, redfish Sebastes and other economical and ecological important species from the survey area. Apart from an annual fishery of about 5,500 tons of Greenland halibut, no fishing effort has in recent years been directed towards groundfish at West Greenland, but an extensive shrimp fishery on traditional fishing grounds is suspected of having a negative effect on the survival rates of recruits. The fishable part of all groundfish stocks seems to have been severely depleted in recent years. The low biomass and abundance of cod, American plaice *Hippoglossoides platessoides*, wolffish *Anarhichas* and starry skate *Raja stellulata* presented in this paper supports this general picture. The survey results do indicate a continued recruitment of Greenland halibut and redfish.

Engelstoft, J.J. and Jørgensen, O. 1998. Biomass and abundance of demersal fish stocks off West Greenland estimated from the Greenland trawl survey 1988-1997. NAFO SCR documents 98/40: 19 p.

Since 1988 the Greenland Institute of Natural Resources has conducted annual bottom trawl surveys off West Greenland. The main purpose of the survey is to evaluate the biomass and abundance of northern shrimp (*Pandalus borealis*), but data on most fish species have also been recorded. This paper presents biomass and abundance estimates together with length frequencies of northern cod (*Gadus morhua*), Greenland halibut (*Reinhardtius hippoglossoides)*, redfish (*Sebastes)* and other economical and ecological important species from the survey in 1997.

Engelstoft, J.J. and Jørgensen, O. 2000. Biomass and abundance of demersal fish stocks off West Greenland estimated from the Greenland shrimp survey, 1988-1999. NAFO SCR documents 00/22: 20 p.

Since 1988 the Greenland Institute of Natural Resources has conducted an annual bottom trawl survey off West Greenland. The main purpose of the survey is to evaluate the biomass and abundance of Northern shrimp (*Pandalus borealis*), but data on the other fish species caught have also been recorded. This paper presents biomass and abundance estimates together with length frequencies of cod (*Gadus morhua*), Greenland halibut (*Reinhardtius hippoglossoides*), redfish (*Sebastes* spp) and other economically and ecologically important species from the survey area. Greenland halibut was found in all divisions, but it was most common in Div. 1AN-1BN. In 1999 the biomass and abundance was estimated at 294 million individuals and 23137 tons. The length distribution ranged between 6 and 42 cm with two clear modes around 15 cm and 23 cm. Redfish was found in all the survey areas, but was usually most common in Div. 1BN and 1C. In recent years abundance and biomass has decreased. In 1999 catches were comprised almost exclusively of species less than 20 cm. Cod is mainly caught south of 68 degree 00'N. Biomass and abundance indices in 1999 were estimated at only 6000 individuals and 115 tons. Too few cod observations were available for length distributions.

Engelstoft, J.J. and Jørgensen, O. 2001. Biomass and abundance of demersal fish stocks off West Greenland estimated from the Greenland shrimp survey, 1988-2000. NAFO SCR documents 01/35: 20 p.

Since 1988 Greenland Institute of Natural Resources has annually conducted a trawl survey off West Greenland. The survey is designed as a stratified random bottom trawl survey mainly aimed at Northern shrimp (*Pandalus borealis*) but data on most fish species are also recorded. In 2000 the biomass of Greenland halibut (*Reinhardtius hippoglossoides*) showed a decrease from 23,000 tons in 1999 to 19,000 tons in 2000 while the abundance increased from 294 million to 350 million specimens, but both estimates are within the range of the estimates since the mid nineties. The recruitment of one year old fish was at an average level in the offshore areas, but the second largest on record in Disko Bay. The biomass and abundance of redfish sp. (*Sebastes*) continued the decline observed since 1997 and was estimated as 10,000 tons, and 184 million specimens, respectively. Biomass and abundance of other economically and ecologically important species are still at low levels and showed little variation compared to recent years.

Engelstoft, J.J. and Jørgensen, O. 2002. Biomass and abundance of demersal fish stocks off West Greenland estimated from the Greenland shrimp survey, 1988-2001. NAFO SCR documents 02/48: 24 p.

Since 1988 Greenland Institute of Natural Resources annually has conducted a bottom trawl survey of West Greenland. The main purpose of the survey is to evaluate the biomass and abundance of Northern shrimp (*Pandalus borealis)*, but data on other fish species have been recorded. This paper presents biomass and abundance estimates together with length frequencies of cod (*Gadus morhua)*, Greenland halibut (*Reinhardtius hippoglossoides*), redfish (*Sebastes mentella*), wolffishes (*Anarhichas* sp), American plaice (*Hippoglossoides platessoides*) and starry skate (*Raja stellulata*) from the 2001 survey.

Ernst, P. 1974. Die Abhaengigkeit des Schwarzen Heilbutts (*Reinhardtius hippoglossoides* Walb.) von den Wassertemperaturverhaeltnissen im Seegebiet Island [Temperature independent behaviour of the black halibut (*Reinhardtius hippoglossoides* Walb.) off the Icelandic coast]. Fisch. Forsch. 12: 35-40.
[In German]

The halibut is to a great extent independent of the environmental conditions and usually remains in the area of the sea-bottom. During the post-spawning phase it keeps to the warm water side of the thermocline (optimum temp 2.0-2.5{degree}C), while during feeding it moves to the cold water side (optimum temp-0.2- + 0.2{degree}C)

Ernst, P. 1982. German Democratic Republic research report for 1981. NAFO SCS documents 82/IX/20: 11 p.

Ernst, P. 1983. German Democratic Republic research report for 1982. NAFO SCS documents 83/IX/23.

Ernst, P. 1984. A contribution to by-catch of Greenland halibut (*Reinhardtius hippoglossoides* Walb.) in the roundnose grenadier (*Coryphaenoides ruprestris* Gunn.) directed fishery in NAFO Subarea 2. NAFO SCR documents 84/IX/96: 8 p.

Due to the discrepency between the by-catch limit under Canadian law on the one hand and the results of the international commercial fishery on the other hand by-catch levels of Greenland halibut in the roundnose grenadier directed fishery in the NAFO Subareas 2 and 3 have become an issue of discussion. In this article results and experiences gathered by the GDR fleet during the commercial fishery in 1982 and 1983 are to be discussed and analyzed in connection with international literature.

Ernst, P. 1984. Ein Beitrag zum Beifang von Scharzem Heilbutt (*Reinhardtius hippoglossoides* Walb.) in der gezielten Fischerei von Grenadierfisch (*Coryphaenoides rupestris* Gunn.) im NAFO-Subarea 2 [A contribution to by-catch levels of Greenland halibut (*Reinhardtius hippoglossoides* Walb.) in the roundnose grenadier (*Coryphaenoides rupestris* Gunn.) directed fishery in NAFO-Subarea 2]. Fisch. Forsch. 22: 47-49.
[In German, English and Russian summaries]

In the period from November 2nd to December 28th 1983 570 hauls of the GDR fleet (Zubringer-Trawler) in the NAFO-Division 2 H were analysed during a "permanent station". An ascertained horizontal and vertical separation of the species roundnose grenadier and Greenland halibut were discussed in connection with the variations in the hydrographic situation of Northwest Atlantic. The cooling of Northwest Atlantic in connection with mentioned fishery biological facts seem to be responsible for the level and trend of by-catch of greenland halibut in the roundnose grenadier directed fishery in the area of Central and Northern Labrador in the fourth quarter of the year.

Ernst, P. 1984. German Democratic Republic research report for 1983. NAFO SCS documents 84/IX/24: 11 p.

Ernst, P. 1985. German Democratic Republic research report for 1985. NAFO SCS documents 85/29: 16 p.

Ernst, P. 1985. Results of the G.D.R. groundfish survey conducted in the Svalbard area in 1984. ICES CM 1985/G:15: 4 p.

Ernst, P. 1986. German Democratic Republic research report for 1985. NAFO SCS documents 86/26: 20 p.

Ernst, P. 1987. Distribution of Greenland halibut (*Reinhardtius hippoglossoides* Walb.) of the Canadian-West Greenland stock in dependence on the temperature level. NAFO SCR documents 87/77: 13 p.

Ernst, P. 1987. On the distribution and stock delimitation of Greenland halibut (*Reinhardtius hippoglossoides* Walb.) in sea areas off East Canada and West Greenland. NAFO SCR documents 87/76: 37 p.

Ernst, P. 1989. Zur Verbreitung und Bestandsabgrenzung der Vorkommen des Schwarzen Heilbutts (*Rheinhardtius hippogossoides* Walb.) in den Seegebieten Ostkanadas und Westgroenlands [On the distribution and stock delimination of Greenland Halibut (*Reinhardtius hippoglossoides* Walb.) in sea areas of East Canada and West Greenland]. Fisch. Forsch. 27: 5-16.
[In German with English and Russian summaries]

Objectives were limitation and identification of Greenland halibut (*Reinhardtius hippoglossoides*) stocks in the Northwest-Atlantic. The results are based on investigations of the GDR within the period from 1968 to 1984 and on analysis of international scientific publications. Within the areas of investigation the occurrences are spawning within the first quarter of the year near the Greenland-Canada-Threshold (62 degree N-65 degree N) below the depth of 1000 m within the range of the warm water component. Males achieve maturity after 6 years of age, females after 7 years of age. Larvae and juveniles are drifting northwards with the West Greenland Current, afterwards the Labrador Current takes them up and transports them to the shelf area of North-Newfoundland. Southwards the abundance decreases gradually. During passive drifting the development of larvae is completed. Juveniles are distributed within the whole area of Labrador up to North-Newfoundland. Juveniles migrate actively northwards from the feeding grounds of Labrador and North-Newfoundland where they had grown up.

Ernst, P. and Borrmann, H. 1987. Zur natuerlichen Sterblichkeitsrate des kanadisch-westgroenlaendischen Schwarzen Heilbutt-Bestandes (*Reinhardtius hippoglossoides* Walb.) [On the natural mortality rate of the Greenland halibut stock (*Reinhardtius hippoglossoides* Walb.) off Canada and West Greenland]. Fisch. Forsch. 25: 11-12. [In German, English and Russian summary]

By means of the methods presented by TAYLOR (1959), Pauly (1978) and CADDY (1984) natural mortality rates were calculated for the Greenland halibut stock off Canada and West Greenland (ERNST 1986) on the basis of biological data sampled during the G.D.R.-offshore-fishery in NAFO Subarea 2 and Divisions 3 K, L from 1977 to 1984. Corresponding to the sex the natural mortality rate ranged from M = 0.230 to M = 0.245 for males and from 0.075 to 0.065 for females. For the total stock the natural mortality rate was estimated to be 0.075 and 0.065 respectively. It is proposed to take M = 0.10 for the estimation of biological statistics of the Greenland halibut stock off Canada and West Greenland.

Ernst, P. and Borrmann, H. 1987. Investigations on growth of the Greenland halibut stock (*Reinhardtius hippoglossoides* Walb.) off Canada and West Greenland. NAFO SCR documents 87/75: 15 p.

Ernst, P. and Borrmann, H. 1987. Natural mortality of Greenland halibut (*Reinhardtius hippoglossoides*) in NAFO Subareas 0 and 2 and Divisions 3KL. NAFO SCR documents 87/10: 4 p.

Ernst, P. and Eggers, R. 1987. German Democratic Republic research report for 1986. NAFO SCS documents 87/23: 11 p.

Ernst, P. and Eggers, R. 1990. German Democratic Republic research report for 1989. NAFO SCS documents 90/16: 9 p.

Ernst, P., Eggers, R., and Nagel, C. 1991. German Democratic Republic research document for 1990. NAFO SCS documents 91/12: 5 p.

Ernst, P., Hoffmann, U., and Vaskov, A.A. 1991. Results on the Greenland halibut survey in Divisions 0B, 1B, 1C and 1D in 1990. NAFO SCR documents 91/21: 5 p.

The Institute for Deep Sea Fisheries and Fish Processing (IfH) Rostock and the Polar Research Institute of Marine Fisheries and Oceanography (PINRO) Murmansk have been cooperating in the stick evaluation of the Greenland and halibut (*Reinhardtius hippoglossoides* WALB.) in the North West Atlantic for years. From September to December 1990, scientists of the IfH once again participated in such a research voyage. The aim of their investigations was to estimate the mean trawlable biomass (MTB) of the Greenland and halibut of the Canadian-West Greenland stock (NAFO 0; 1; 2; 3K) in the sea areas off Canada and West Greenland (NAFO divisions 0B; 1B; C; D; 2G; H).

Etienne, M., Jérôme, M., Fleurence, J., Rehbein, H., Kündiger, R., Mendes, R., Costa, H., Pérez-Martín, R., Pineiro-González, C., Craig, A., Mackie, I., Malmheden Yman, I., Ferm, M., Martínez, I., Jessen, F., Smelt, A., and Luten, J. 2000. Identification of fish species after cooking by SDS-PAGE and urea IEF: a collaborative study. J. Agric. Food Chem. 48: 2653-2658.

A collaborative study, to validate the use of SDS-PAGE and urea IEF, for the identification of fish species after cooking has been performed by nine laboratories. By following optimized standard operation procedures, 10 commercially important species (Atlantic salmon, sea trout, rainbow trout, turbot, Alaska pollock, pollack, pink salmon, Arctic char, chum salmon, and New Zealand hake) had to be identified by comparison with 22 reference samples. Some differences in the recoveries of proteins from cooked fish flesh were noted between the urea and the SDS extraction procedures used. Generally, the urea extraction procedure appears to be less efficient than the SDS extraction for protein solubilization. Except for some species belonging to the Salmonidae family (*Salmo, Oncorhynchus*), both of the analytical techniques tested (urea IEF, SDS-PAGE) enabled identification of the species of the samples to be established. With urea IEF, two laboratories could not differentiate *Salmo salar* from *Salmo trutta*. The same difficulties were noted for differentiation between *Oncorhynchus gorbuscha* and *Oncorhynchus keta* samples. With SDS-PAGE, three laboratories had some difficulties in identifying the *S. trutta* samples. However, in the contrast with the previous technique, SDS-PAGE allows the characterization of most of the *Oncorhynchus* species tested. Only *Oncorhynchus mykiss* was not clearly recognized by one laboratory. Therefore, SDS-PAGE (Excel gel homogeneous 15%) appears to be better for the identification, after cooking, of fish such as the tuna and salmon species which are characterized by neutral and basic protein bands, and urea IEF (CleanGel) is better for the gadoid species, which are characterized by acid protein bands (parvalbumins). Nevertheless, in contentious cases it is preferable to use both analytical methods.

Fairbairn, D.J. 1981. Biochemical genetic analysis of population differentiation in Greenland halibut (*Reinhardtius hippoglossoides*) from the Northwest Atlantic, Gulf of St. Lawrence, and Bering Sea. Can. J. Fish. Aquat. Sci. 38: 669-677.

Greenland halibut (*Reinhardtius hippoglossoides*) from the Northwest Atlantic Ocean, the Gulf of St. Lawrence, and the Bering Sea were analyzed for allele and genotype frequencies at 16 electrophoretically detectable protein loci. Thirteen of these loci were monomorphic, with identical mobilities in all samples. One locus (MDH-1) was polymorphic only in the Bering Sea sample. Two loci, PGM and PHI-2, were polymorphic in all samples. An analysis of allele frequencies at these latter loci indicated that Greenland halibut from the Northwest Atlantic area form a single genetically homogeneous stock, but that those in the Gulf of St. Lawrence form a separate though not completely isolated stock. Greenland halibut from the Bering Sea differ greatly from these, and a genetic distance estimate based on all 16 loci suggested genetic divergence at the subspecific level between the two oceans.

FAO Coordinating Working Party on Atlantic Fishery Statistics 1970. Notes on catch statistics of North Atlantic halibut and Greenland halibut. FAO (Food and Agriculture Organization of the United Nations) Fisheries Circular. 251: 7 p.

Fedorov, E.K. 1979. Oogenesis and the sexual cycle of the Greenland halibut. Can. Transl. Fish. Aquat. Sci. 4558: 45 p.
[Translated from Russian: Ovogenez i polovoi tsikl chernogo paltusa In: Trudy Polyarnogo nauchno-issledovatel'skogo i proektnogo instituta morskogo rybnogo khozyaistva i okeanografii is. N.N. Knipovicha (PINRO) 23: 425-450]

In the present work is presented the first results of a study of oogenesis and the sexual cycle of the Greenland halibut, a "scale" for determining the stage of ovarian saturation and the question of spawning type is raised.

Fedorov, K.E. 1971. The condition of the sex glands in the Barents Sea Greenland halibut *Reinhardtius hippoglossoides* (Walb.) which failed to spawn during the spawning season. Vopr. Ikhtiol. 11: 785-793.
[In Russian]

Fedorov, K.E. 1971. Types of hypophyseal secretory cells and analysis of gonadotrophs with reference to pattern of spawning in the Greenland halibut *Reinhardtius hippoglossoides*. Arkh. Anat. Gistol. Embriol. 48: 98-107.
[In Russian, English summary]

Six types of secretory cells were determined in the Greenland halibut (*Reinhardtius hippoglossoides* Walbaum) on the base of analysis of the structure of trhe adenohypophysis. Staining properties, granulation patterns, disposition, shape, size of cells and their nuclei were always specific for each type of secretory elements despite the variability of these features. Two types of acidophiles were found in the rostral zone; one of them were similar to "erythrosinophilic" (or prolactin-secreting) cells, and the others were similar to "alisarinophiles" (or corticotropic) cells described in other fishes. Two kinds of basophils were found in the proximal zone: acidophilic (somatotropic) and chromophobic cells. Both types were PAS positive. Gonadotropic basophils were identified considering their ontogenetically late differentiation, close functional relation to the process of reproduction in mature females and hyperfunction in sterile fishes. The other kind of basophils was probably responsible for production of theyreotropin. Chromatophobic cells localized medially were established to be a reservoir for complementary production of gonadotrops in the periods of intensification of pituitary function. According to the patterns of processes of acuumulation and release of gonadotropic hormone during spawning, hablibut is close to the fishes having a single autumn - winter spawning.

Fedorov, K.E. 1971. Zoogeographic characteristics of the Greenland halibut *Reinhardtius hippoglossoides* (Walbaum). Vopr. Ikhtiol. 11: 1102-1105.
[In Russian]

Finley, K.J. and Gibb, E.J. 1982. Summer diet of the narwhal (*Monodon monoceros*) in Pond Inlet, northern Baffin Island. Can. J. Zool. 60: 3353-3363.

Stomach contents of 73 narwhals (*M. monoceros*) taken in Pond Inlet during June-Sept. 1978-1979 were examined. Arctic cod (*Boreogadus saida*) and Greenland habitat (*Reinhardtius hippoglossoides*) comprised 51 and 37%, respectively, of the diet by weight. Arctic cod contributed 57% in 1978 but only 29% in 1979. Squid (*Gonatus fabricii)* beaks were abundant but not representative of recent intake. Deeper fish (halibut, redfish (*Sebastes marinus*), and polar cod (*Arctogadus glacialis*)), found primarily in male narwhals, indicate a deep diving (> 500 m) capability. The largest measured weight of stomach contents was 10.1 kg and weights projected from otoliths did not exceed 19.6 kg. No selection of prey items by size was evident amongst various sex and age groups of narwhals. Feeding was most intensive at the ice edge and ice cracks but little feeding took place in the fiords during late summer. Blubber thickness declined in females but not in males during the summer. The significance of traditional summering areas appears to be related to calving requirements and not to feeding opportunities.

Fischer, J. and Haedrich, R.L. 1999. Changes in the temperature/depth niche occupied by demersal fishes in the Northwest Atlantic between 1978 and 1993. Arch. Fish. Mar. Res. 47: 1-15.

Realised temperature/depth niches of 16 demersal fish species of the Newfoundland continental shelf are visualised graphically with a novel method, and annual patterns from 1978 to 1993 are described. Together the graphical visualisation of realised temperature/depth niche space and the associated niche width (Ht) can be used to differentiate a species' niche from that of co-existing species; they can also be used to assess changes over rime in a single species or a whole community of species. The study period was one during which disturbances from declining sea temperature and heavy fishing effort, increased across the Newfoundland shelf ecosystem and many fish species declined in abundance and/or average size of individuals. The analyses showed trends towards occupation of deeper water over time in most fish species studied. These were mostly accompanied by a significant reduction in the size of realised niche space.

Fisheries Diversification Program (Canada). 1995. The science and conservation of Greenland halibut (Turbot) [videorecording]. St. John's, NF, Fisheries Diversification Program (Canada). 1 videocassette (44 min.)
[VHS]

Fisheries Diversification Program (Canada). 2001. Environmental Awareness & Conservation Technology Component and Aquaprojects Inc. Otter trawl turbot selectivity experiments in 0B2G by the Clearwater FV Atlantic Enterprise, May-June, 2000. Project report (Fisheries Diversification Program (Canada). Environmental Awareness & Conservation Technology Component) EACT-7.2001: 35 p.

The main objective of the comparative study carried out aboard the Atlantic Enterprise was to compare the performance of a standard turbot trawl with one having the fore part constructed of small mesh in reducing the capture of small undersize turbot. Specifically the study was to: a) quantify the incidence (number) and weight of small fish retained in a standard (145 mm) cod-end and in the fore part of the standard turbot trawl; b) quantify the incidence (number) and weight of small fish retained in the cod-end of the experimental gear (145 mm cod-end) having the fore part of the net constructed of small mesh (100 mm); and c) measure the length frequency (size composition) of the catch in : i) the standard cod-end (145 mm mesh); ii) the fore part of the standard trawl; and iii) the experimental cod-end (145 mm), having small mesh in the fore part.

Fisheries Diversification Program (Canada). 2001. Environmental Awareness & Conservation Technology Component and Aquaprojects Inc. Otter trawl turbot selectivity experiments in 3KL by the F.P.I. FV Pennysmart, May-June, 2000. Project report (Fisheries Diversification Program (Canada).Environmental Awareness & Conservation Technology Component) EACT-6.2001: 44 p.

Two major objectives of the turbot research carried out aboard the F.V. Pennysmart was to obtain selectivity data related to turbot and to gather information on the effect of using small meshes in the forepart of the trawl in reducing or eliminating the capture of small fish. Specifically the research was designed to: a) obtain sufficient and appropriate data to successfully generate selectivity curves for a typical 145 mm turbot trawl cod-end; b) quantify the incidence (number) of small fish retained in a standard (145 mm) cod-end, the various parts (front end, mid section, and cod-end) of the "Millennium" (standard) trawl, and the millennium trawl with a 80 mm mesh installed in the forepart of the net. c) measure the length frequency (size composition) of the catch in: i) the millennium (standard) 145 mm mesh cod-end; ii) the various parts of the standard net having a 80 mm mesh installed in the front of the trawl; and iii) a small mesh cod-end (50 mm).

Fisheries Diversification Program (Canada). 2001. Environmental Awareness & Conservation Technology Component and Aquaprojects Inc.. Report on Greenland halibut (turbot) selectivity experiments carried out aboard the Atlantic Enterprise (Phase II). Project report (Fisheries Diversification Program (Canada).Environmental Awareness & Conservation Technology Component) EACT-8.2001: 1 v.

The primary objective of the research study carried out aboard the M.V. Atlantic enterprise during phase II was to find ways of reducing or eliminating the capture of small turbot in offshore trawling operations targeting turbot. Specifically, the research was designed to: a) generate selectivity curves for a standard turbot trawl constructed of nominal 160 mm mesh in the fore part and a 145 mm cod-end; b) generate selectivity

curves for a turbot trawl having small mesh in the fore part (100 mm) and a 145 mm mesh cod-end; and c) compare the catch performance (quantity and size) of a standard turbot trawl (160 mm mesh in the fore part and a 145 mm cod-end) with one having the fore part constructed of small (100 mm) mesh.

Fisheries Resource Conservation Council (Canada). 1994. A report to the Minister of Fisheries and Oceans on Greenland halibut (Turbot) in NAFO subareas 0, 1, 2, and 3. Fisheries Resource Conservation Council (Canada) FRCC.94.R.3: 19 p.

Fisheries Resource Conservation Council (Canada) and Canada. Dept. of Fisheries and Oceans. 1994. Conservation: stay the course : Fisheries Resource Conservation Council report to the Minister of Fisheries and Oceans 1995 conservation measures for Atlantic groundfish. Fisheries Resource Conservation Council (Canada) FRCC.94.R4E: 141 p.

Fisheries Resource Conservation Council (Canada) and Canada. Dept. of Fisheries and Oceans. 1998. Conservation must be compulsory, not optional : annual report of the Fisheries Resource Conservation Council and conservation requirements for Atlantic groundfish stocks for 1998. Fisheries Resource Conservation Council (Canada) FRCC.98.2: 225 p.

Fisheries Resource Conservation Council (Canada) and Canada. Dept. of Fisheries and Oceans. 1999. Fisheries in transition : annual report of the Fisheries Resource Conservation Council and conservation requirements for Atlantic groundfish stocks for 1999. Fisheries Resource Conservation Council (Canada) FRCC.99.R.4: 205 p.

Fisheries Resource Conservation Council (Canada) and Canada. Dept. of Fisheries and Oceans. 2000. Uncharted waters : annual report of the Fisheries Resource Conservation Council and conservation requirements for Atlantic groundfish stocks for 2000. Fisheries Resource Conservation Council (Canada) FRCC.99.R.4: 171 p.

Fisk, A.T., Tittlemier, S.A., Pranschke, J.C., and Norstrom, R.J. 2002. Using anthropogenic contaminants and stable isotopes to assess the feeding ecology of Greenland sharks. Ecology (Wash. D.C.) 83: 2162-2172.

Organochlorine contaminants (OCs) are a large group of ubiquitous pollutants that have potential as tracers of ecological processes. To examine this utility, we measured OCs, stable isotopes of nitrogen ([Delta]15N) and carbon ([Delta]15C), and stomach contents in a large Arctic marine fish, the Greenland shark (*Somniosus microcephalus*), collected in the Davis Strait region to examine the feeding ecology of this little studied elasmobranch. Stable isotopes and OCs were also measured in the turbot (*Reinhardtius hippoglossoides*) and stable isotopes in the ringed seal (*Phoca hispida*) and harp seal (*Pagophilus groenlandicus)* to put the shark results in context. Values of [Delta]15N suggest that the Greenland shark feeds at a similar trophic level as the turbot and ringed seal (about the fourth trophic level) and at a higher trophic level than harp seals, despite the presence of many turbot and a single ringed seal in the stomach contents of 14 sharks. Values of [Delta]13C indicate that source of carbon in turbot and Greenland shark is of a more pelagic origin than in ringed and harp seals. High concentrations of biomagnifying OCs in the sharks compared with the turbot (concentration 10-100X lower) and ringed seals (3-10X lower) suggest that the sharks feed at a higher trophic level than implied by stable isotopes. High urea levels found in the tissues of sharks may influence [Delta]15N values, resulting in an underestimate of shark trophic position, and requires additional study. The presence of a ringed seal in the stomach of one shark, relatively high levels of a contaminant metabolite (oxychlordane; slowly formed in fish) in some sharks, and high OC levels suggest that seals may be a common food item of some Greenland sharks. This study shows the utility of using OCs in ecological study and suggests caution when interpreting stable-isotope data as a single indicator of trophic position.

Folkow, L.P. and Blix, A.S. 1999. Diving behaviour of hooded seals (*Cystophora cristata)* in the Greenland and Norwegian Seas. Polar Biol. 22: 61-74.

Satellite-linked dive recorders were used to collect data on depths and durations of ~120,000 dives by 16 hooded seals (*Cystophora cristata*). Following tagging after moult (four males, eight females) and breeding (four females) off east Greenland, seals dispersed widely in the northeast Atlantic during 172 +/- 97 days (mean satellite-linked dive recorder lifetime +/- SD). Meso/bathypelagic dives of 5- to 25-min duration to 100-600 m dominated (75%), but some very deep (>=1016 m) and long (>52 min) dives occurred. Diving in open ocean was continuous, with an estimated 90.7+/-0.8% (mean+/-SE) of time spent submerged. The proportion of time spent submerged was similar during night and day, but dives during the day were generally deeper and longer (*Reinhardtius hippoglossoides)*, redfish *(Sebastes* spp.), polar cod (*Boreogadus saida)*, herring (*Clupea harengus*), squid (*Gonatus fabricii)* and blue whiting (*Micromesistius poutassou*) are important prey of hooded seals.

Folmer, O. 1999. Denmark/Greenland research report for 1998. NAFO SCS documents 99/17: 6 p.

Frank, K. 1996. Eastern Scotian Shelf Greenland halibut (turbot). DFO Atlantic fisheries stock status report 96/73: 2 p.

Frank, K. 1996. Le flétan du Groenland du plateau neo-ecossais. MPO Pêches de l'Atlantique rapport sur l'état des stocks 96/73F: 2 p.
[In French]

Frank, K.T., Carscadden, J.E., and Simon, J.E. 1996. Recent excursions of capelin (*Mallotus villosus*) to the Scotian Shelf and Flemish Cap during anomalous hydrographic conditions. Can. J. Fish. Aquat. Sci. 53: 1473-1486.

Episodic occurrences of capelin (*Mallotus villosus)* outside their normal range were evident from examination of current and historical records of the Scotian Shelf and Flemish Cap. Capelin reappeared in both locales, beginning in the late 1980s (Scotian Shelf) and early 1990s (Flemish Cap), concomitant with anomalous meteorological and hydrographic conditions and an abrupt decline in offshore abundance in their principal centre of distribution (division 2J3KL). Movement of capelin to these regions is associated with lower than normal ocean temperatures but not with warmer than normal conditions. In both locales adult capelin were the first to appear, and spawning was evident; successful reproduction has occurred on the Scotian Shelf (a 1993 year-class formed). The increase in capelin abundance was not limited to the eastern Scotian Shelf and Flemish Cap, and capelin was not the only species involved. Capelin in the southern Gulf of St. Lawrence exhibited a very similar temporal pattern of abundance, and two Arctic-boreal species (Greenland halibut (*Reinhardtius hippoglossoides)* and checker eelpout (*Lycodes vahlii)*) exhibited spatial and temporal patterns of abundance similar to those of capelin on the Scotian Shelf. We suggest that capelin may serve as an instructive analog for assessment of the relative influences of environmental effects and fishing on heavily exploited species.

Fréchet, A. 1986. Le flétan du Groenland des divisions 4R, 4S et 4T de l'OPANO [Greenland halibut in NAFO Division 4RST]. CAFSAC Res. Doc. 86/106: 18 p.
[In French]

Fréchet, A. 1987. Biology and fishery of Greenland halibut in the gulf of St. Lawrence. NAFO SCR documents 87/95: 11 p.

Fréchet, A. 1987. Exploitation du flétan du Groenland *(Reinhardtius hippoglossoides*) du golfe du Saint-Laurent en 1986 [Exploitation of Greenland halibut (*Reinhardtius hippoglossoides)* in the Gulf of St. Lawrence in 1986]. CAFSAC Res. Doc. 87/56: 23 p.
[In French]

Fréchet, A. and Ouellet, G. 1984. Quelques données sur le flétan du Groenland de 4RST. Document de recherche (Québec (Province).Sous-ministériat aux pêches maritimes.Direction de la recherche scientifique et technique) 84/24, 21 p.

Landings of Greenland halibut in the Gulf of St.Lawrence have dropped 54% between 1982 and 1983, this being mainly due to the low catch of the Quebec based gill-net fishery in 4t (419 t in 1983 and 1 716 t in 1982). This drop could be attributed to the disappearance of the strong 1972 to 1975 year-classes from the fishery which represented the majority of the catches for the last six years. The 1979 year-class appears strong and should make an important contribution to the 1985 fishery.
[In French]

Fréchet, A. and Ouellet, G. 1984. Quelques données sur le flétan du Groenland de 4RST [What gives with the Greenland halibut of 4RST]. CAFSAC Res. Doc. 84/62: 21 p.
[In French]

Fréchet, A. and Ouellet, G. 1985. Le flétan du Groenland (*Reinhardtius hippoglossoides*) des divisions 4RST de l'OPANO. Document de recherche (Québec (Province).Sous-ministériat aux pêches maritimes.Direction de la recherche scientifique et technique) 85/24, 17 p.
[In French, English summary]

For the first time since 1979 Greenland halibut landings in NAFO divisions 4RST have increased (from 1104 t. in 1983 to 1787 t. in 1984). Gillnets present in division 4T contributed the most to the increased landings. The strong 1979 year class is starting to show up in the shrimper's by-catch.

Fréchet, A. and Ouellet, G. 1985. Le flétan du Groenland (*Reinhardtius hippoglossoides*) des divisions 4RST de l'OPANO [Greenland halibut (*Reinhardtius hippoglossoides*) in NAFO Division 4RST]. CAFSAC Res. Doc. 85/80: 17 p.
[In French]

Froescheis, O., Looser, R., Cailliet, G.M., Jarman, W.M., and Ballschmiter, K. 2000. The deep-sea as a final global sink of semivolatile persistent organic pollutants? Part I: PCBs in surface and deep-sea dwelling fish of the North and South Atlantic and the Monterey Bay Canyon (California). Chemosphere 40: 651-660.

The understanding of the global environmental multiphase distribution of persistent organic pollutants (POPs) as a result of the physico-chemical properties of the respective compounds is well established. We have analysed the results of a vertical transport of POPs from upper water layers (0-200 m) to the deepwater region (>800 m) in terms of the contamination of the biophase in both water layers. The contents of persistent organochlorine compounds like polychlorinated biphenyls (PCBs) in fish living in the upper water layers of the North Atlantic and the South Atlantic, and at the continental shelf of California (Marine Sanctuary Monterey Bay and its deep-sea Canyon) are compared to the levels in deep-sea or bottom dwelling fish within the same geographic area. The deep-sea biota show significantly higher burdens as compared to surface-living species of the same region. There are also indications for recycling processes of POPs-in this case the PCBs-in the biophase of the abyss as well. It can be concluded that the bio- and geo phase of the deep-sea may act similarly as the upper horizons of forest and grasslands on the continents as an ultimate global sink for POPs in the marine environment.

Gagnon, M. 1986. Pêche expérimentale du turbot et de la morue à l'aide de palangres suprabenthiques dans le Nord-Ouest du Golfe St-Laurent [Experimental fishing for turbot and cod with longlines in the Northwest Gulf of St. Lawrence]. Rapport de projet 19, 66 p. [In French]

Les résultats obtenus avec des palangres suprabenthiques munies d'hameçons circulaires ont amené le ministère à entrevoir la possibilité d'utiliser ce type d'engin pour la pêche au flétan du Groenland. Le ministère a confié à la firme Bio-Conseil Inc. le mandat de comparer l'efficacité de palangres suprabenthiques munies d'hameçons circulaires à celle des filets maillants pour la pêche au turbot. Le présent rapport décrit les résultats de la pêche experimentale au turbot ainsi que ceux d'une pêche de démonstration à la morue réalisée dans la région de Tourelle.

Gascon, D. 1994. Rapport sur l'état des stocks de poissons pour la Région du Québec en 1994 = Fish stocks status report for the Quebec region in 1994. Can. Manuscr. Rep. Fish. Aquat. Sci. 2253: 75 p.
[In French and English in parallel columns]

Fish stock assessments were reviewed regionally for the first time in 1994. This document describes in detail the technical basis for the assessment of fish stocks made at the Maurice Lamontagne Institute in May 1994. The stocks described are: herring (*Clupea harengus*) on the west coast of Newfoundland, cod (*Gadus morhua*) in the northern Gulf of St-Lawrence, mackerel (*Scomber scombrus*) in the northwest Atlantic, redfish *Sebastes* spp. in the Gulf of St-Lawrence and Greenland halibut (*Reinhardtius hippoglossoides*) in the Gulf. Summaries of climatic conditions in the Gulf of St-Lawrence in 1993, and of the status of the main biological components are also included. This report provides the technical descriptions supporting the conclusions on stock status in 1994.

Gascon, D. 1995. Collected stock status reports for 1994 : fish stocks in the Gulf of St. Lawrence assessed by the Laurentian Region in 1995. Can. Manuscr. Rep. Fish. Aquat. Sci. 2335: 97 p.

The present document is a compilation of stock status reports that describe important results and main conclusions pertaining to the conservation and management of seven fish stocks from the Gulf of Saint-Lawrence, and to the environmental conditions in the Gulf of Saint-Lawrence in 1994. These reports represent biological input to the Fisheries Resources Conservation Council and fisheries managers which allows them to formulate advice on conservation and to draw management plans for these resources. The stocks included in this report are: herring (*Clupea harengus*) capelin, (*Mallotus villosus*) cod (*Gadus morhua*), Greenland halibut (*Reinhardtius hippoglossoides*) Atlantic halibut (*Hippoglossus hippoglossus*) redfish (*Sebastes*); and finally mackerel (*Scomber scombrus*).

Gascon, D. 1995. Compilation des rapports sur l'état des stocks en 1994: stocks de poissons du golfe du Saint-Laurent évalués par la Région des Laurentides en 1995 [Collected stock status reports for 1994: fish stocks in the Gulf of Saint-Lawrence assessed by tghe Laurentian Region in 1995]. Can. Manuscr. Rep. Fish. Aquat. Sci. 2335: 115 p.
[In French]

The present document is a compilation of eight stock status reports that describe important results and main conclusions pertaining to the conservation and management of seven fish stocks from the Gulf of Saint-laurence, and to the environmental conditions in the Gulf of Saint-Laurence in 1994. These reports represent biological input to the Fisheries Resources Conservation Council and fisheries managers which allows them to formulate advice on conservation and to draw management plans for these resources.

The stock included in this report are: herring in the northern Gulf of St. Lawrence, capelin in the Gulf, cod in the northern Gulf, Greenland halibut in the Gulf, Atlantic halibut in the Gulf, redfish in the Gulf, and finally mackerel in the northwest Atlantic.

Gauthier, J. and Castonguay, M. 2005. Flétan du Groenland du golfe du Saint-Laurent (4RST) en 2004 [Gulf of St. Lawrence (4RST) Greenland halibut in 2004]. Secrétariat canadien de consultation scientifique avis scientique 2005/012: 9 p.
[In French]

Geistdoerfer, P. 1982. L'exploitation commerciale des poissons de grande profondeur dans l'atlantique nord [The commercial fishery of deep-sea fishes in the North Atlantic]. Oceanis 8: 29-55.
[In French]

The overfishing of commercial fishes and the extension of national fishing limits during the last ten years have obliged the fishing fleet to trawl in the North Atlantic on new deep-water grounds, at depths between 200 and 1,500 m. New deep-sea fishes are caught and appear on the market. Among these are the Gadidae: blue ling *Molva dypterygia* , blue whiting *Micromesistius poutassou* ; Macrouridae: grenadiers *Macrourus berglax* and *Coryphaenoides rupestris* ; Pleuronectidae: Greenland halibut *Reinhardtius hippoglossoides*; Trichiuridae: black scabbard fish *Aphanopus carbo* . This has led, in recent years, to much research which is reviewed here.

Gerasimova, O.V., Albikovskaya, L.K., and Melnikov, S.P. 1991. Preliminary results from feeding analysis for abundant commercial fishes on the Newfoundland Bank in April-May 1991. NAFO SCR documents 91/125: 20 p.

Data on feeding intensity and stomach content of cod, Greenland halibut and American plaice obtained in spring-summer bottom fish surveys carried out on the Grand Newfoundland Bank were presented. Length composition of main food objects of abundance commercial fishes has been examined. American plaice along with cod and Greenland halibut was shown to be also an active consumer of capelin.

Gibson, R.N. 2005. Flatfishes: biology and exploitation. Blackwell Science, Oxford, UK.. 406 p.

This volume presents timely and comprehensive 'state of the art' reviews of flatfish biology, ecology and flatfish fisheries, and readers will find the elements of a fresh synthesis concerning the role of flatfish in today's depleted marine ecosystems.
Notes: Includes bibliographical references and indexes

Gil, J.G., Ruiz, M., de Cárdenas, E., and Rodriguez-Marin, E. 1997. Contrast between day and night Greenland halibut yields from catches by Spanish commercial fleet, during the period 1991-94 in NAFO Divisions 3LMN. NAFO SCR documents 97/36: 7 p.

Greenland halibut (*Reinhardtius hippoglossoides*) day and night yields were estimated for 1991-1994 from 8 361 hauls made by Spanish commercial fleet fishing in the NAFO Area with observers on board at least a third of the fleet. The target species of the fishery is Greenland halibut caught at depths of between 800 and 1 500 metres. This species makes up more than 60% of the total catch and so the CPUE of the fleet may be considered as being directed at this species. Results show that day and night yields present the same variations, and same trends. Similarity between day and night yields seems to be present in the three divisions and in each depth strata. It seems evident that the factor analyzed in this study is not determinant in the behaviour of the resource, which is a fact of some interest when designing scientific surveys, since the results of night-time hauls will be directly comparable with those made during daylight.

Gil, J.G., de Cárdenas, E., and Rodriguez-Marin, E. 1997. Evolution of yields and mean lengths of the catch of Greenland halibut in Divisions 3LMNO of the NAFO Regulatory Area. NAFO SCR documents 97/35: 5 p.

From the data supplied by obervers on board the Spanish commercial fleet, we will analyze yields and mean lengths of Greenland halibut in two areas, North and South, clearly distanced within the NAFO Regulatory Area, quarterly in the period 1992-1994. We found patterns of seasonality in both yields and mean lengths, in the two areas of the study, which will indicate seasonal displacements of immature specimens of the population.

Gillis, D.J. and Allard, M.R. 1984. Killiniq fisheries project: phase I. Makivik Corporation. Research Department, Quebec. 1 v.

Gillis, D.J. and Allard, M.R. 1984. Projet des pêcheries de Killiniq: phase I [Killiniq fisheries project: phase I]. Societe Makivik. Service de la recherche, Québec. 300 p. [In French]

Gillis, D.J. and Allard, M.R. 1986. Killiniq fisheries project: phase II. Makivik Corporation. Research Department, Quebec. 1 v.

Gillis, D.J. and Allard, M.R. 1986. Projet des pêcheries de Killiniq: phase II [Killiniq fisheries project: phase II]. Societe Makivik. Service de la recherche, Québec. 1 v. [In French]

Gillis, D.J., Allard, M.R., and Axelsen, F. 1987. Killiniq fisheries project: phase III. Makivik Corporation. Research Department, Quebec. 113 p.

The Killiniq Fisheries Project was created to study the feasibility of redeveloping a commercial inshore marine fishery based in northeastern Ungava Bay to be operated by indigenous people. Field studies relating to the project were undertaken between 1983 and 1985. The first study component was an exploratory fishing program. The second major component was a program to design and field test a fixed trap for harvesting Arctic charr from their marine summering areas. This program was quite successful resulting in a prototype which fished well while minimizing mortality. A diversified operation would seem to be major key to long term stability in operating in such an area as Killiniq. Various combinations of the single-resource fisheries can be shown to 1) reduce the cost of production, hence the market value required for break-even and 2) dampen the effects offluctuations in resource availability and market prices.

Gillis, D.J., Allard, M.R., and Axelsen, F. 1987. Projet des pêcheries de Killiniq: phase III [Killiniq fisheries project: phase III]. Societe Makivik, Québec. 107 p. [In French]

Le Projet des Pêcheries de Killiniq a été créé pour étudier la faisabilité de relancer une entreprise de pêche marine cotière, basée dans le nord de la baie d'Ungava, et exploitée par les Autochtones et à leur profit. Les études sur le terrain sont déroulées de 1983 à 1985. Le présent rapport concerne la phase III (1985) de ces études, mais comporte également des donnés provenant de toutes les sources consultées; il évalue aussi globalement la faisabilite de mettre sur pied une pêcheries dans la région.

Gobeil, C., Clermont, Y., and Paquette, G. 1997. Concentrations en mercure, plomb et cadmium chez diverses espèces de poissons de fond, de poissons pélagiques et de crustacés de l'estuaire et du golfe du Saint-Laurent et du fjord du Saguenay [Concentrations of mercury, lead and cadmium in different species of groundfish, pelagic fish and crustaceans from the Estuary and Gulf of St. Lawrence and from the Saguenay Fjord].

Can. Data Rep. Fish. Aquat. Sci. 1011: 88 p.
[In French, English summary]

Concentrations of mercury, lead, and cadmium were determined in the muscle of northern shrimp (*Pandalus borealis*), in the muscle and hepatopancreas of snow crab (*Chionoecetes opilio*), and in the muscle, liver, and gonads of several fish species from the Estuary and Gulf of St. Lawrence and from the Saguenay Fjord. The fish species include Atlantic cod *(Gadus morhua)* , Greenland halibut (*Reinhardtius hippoglossoides*), deepwater redfish (*Sebastes mentella*), American plaice (*Hippoglossoides platessoides*), thorny skate (*Raja radiata*), capelin (*Mallotus villosus*), Atlantic herring (*Clupea harengus*), and rainbow smelt (*Osmerus mordax*). The mercury concentrations in tissues of all species were 2 to 10 times lower than the Canadian guideline established to ensure human health protection, with the exception of those in the northern shrimp and snow crab from the Saguenay Fjord, which were near the guideline. Lead concentrations were low, and did not differ markedly, regardless of the species or the tissue, or whether it was from the gulf, the estuary or the fjord. Cadmium concentrations in fish muscle and gonads and in crustacean muscle were also low regardless of the location.

Godinho, L., Alpoim, R., Carneiro, M., and Ávila de Melo, A.M. 1991. Portuguese research report for 1990. NAFO SCS documents 91/15: 51 p.

Godinho, M.L. 1988. Portuguese research report for 1987. NAFO SCS documents 88/12: 8 p.

Godinho, M.L. 1989. Portuguese research report for 1988. NAFO SCS documents 89/15: 12 p.

Godinho, M.L. and Alpoim, R. 1997. Essays on baking technique of Greenland halibut otoliths for ageing purposes. NAFO SCR documents 97/67: 3 p.

Although there was an evident variability of results in each assay it appears acceptable to conclude that 1) the use of the baking technique for ageing Greenland halibut (*Reinhardtius hippoglossoides)* otoliths has advantages relative to those untreated; 2) the use of some enhanced solution for an appropriate time improves the contrast between the opaque and hyaline rings; 3) results obtained when using a baking temperature of 250 degree C/30-60 min (depending on the size of the otoliths) appeared better than the ones obtained when 180 degree C, 220 degree C or 280 degree C are used.

Godinho, M.L., Alpoim, R., Ávila de Melo, A.M., and Santos, E. 1996. Portuguese research report for 1995. NAFO SCS documents 96/12: 61 p.

Godinho, M.L., Alpoim, R., Ávila de Melo, A.M., and Santos, E. 1997. Portuguese research report for 1996. NAFO SCS documents 97/9: 43 p.

Godoe, O.R. and Haug, T. 1985. A preliminary report on the migration and recruitment to the commercial stock of Greenland halibut, *Reinhardtius hippoglossoides*, in the Svalbard area. ICES CM 1985/G:18: 19 p.

In the present paper the migration of Greenland halibut in the Svalbard area is examined using a) trawl indices and length distribution of Greenland halibut caught during stratified trawl surveys along the slope of the continental shelf in the Svalbard area north and south of 78 deg N, and b) tagging and recapture of juvenile Greenland halibut in Spitzbergen coastal waters.

Godoe, O.R. and Haug, T. 1987. A review of the natural history, fisheries and management of Greenland halibut (*Reinhardtius hippoglossoides*) in the eastern Norwegian and Barents Sea. NAFO SCR documents 87/74: 28 p.

Godoe, O.R. and Haug, T. 1987. Migration and recruitment to the commercial stock of Greenland halibut, *Reinhardtius hippoglossoides* (Walbaum), in the Svalbard area. Fiskeridir. Skr. Ser. Havunders. 18: 311-328.

Results of stratified bottom trawl surveys in the Svalbard area (Barents Sea) during the period 1983-1985 show that depth distribution of Greenland halibut (*Reinhardtius hippoglossoides*) is size dependent. Higher proportions of large fish are found in deeper strata. The species exhibits geographically heterogeneous length distributions with a relatively high proportion of small fish north of 76 degree N. This inter-area heterogeneity could be attributed to a southwards migration of larger fish from nursery grounds in the north. Recaptures of fish tagged in the northern area support this view in that fish not recaptured in the release area had moved southward. A general decrease in abundance of small Greenland halibut was observed in the Svarlbard area. This is interpreted as indicating reduced recruitment success. A possible connection between the decreasing recruitment of Greenland halibut and an increase of young cod, *Gadhus morhua*, abundance is discussed.

Godoe, O.R. and Haug, T. 1987. Preliminary report on recruitment variation in Greenland halibut (*Reinhardtius hippoglossoides* Walb.) in the Svalbard area. NAFO SCR documents 87/83: 14 p.

Godoe, O.R. and Haug, T. 1989. A review of the natural history, fisheries, and management of Greenland halibut (*Reinhardtius hippoglossoides*) in the eastern Norwegian and Barents Seas. ICES J. Mar. Sci. 46: 62-75.

Golovan, G.A., Pakhorukov, N.P., and Sysa, V.N. 1990. Distribution and behavior of deep-water fishes near Kuril Islands Russian SFSR USSR. Biol. Morya 1990: 70-72.
[In Russian]

The data were obtained on the distribution and behaviour of 19 species (*Bathyraja* spp., *synaphobranchus kaupi*, N*otacanthus chemnitzii, Antimora rostrata, Laemonema longipes, Coryphaenoides pectoralis, C. acrotepsis, C. cinereus, Lumperella longirostris, Lycodes sp., Allolepis holland, Sebastolobus macrochir, Paraliparis melanobranchus, Careproctus* sp., *Malacocottus Zonurus, Psychrolutes paradoxus, Atherestes evermanni, A. stomias, Reinhardtius hippoglossoides matsuure*) of demersal and near bottom fishes of Kuril Islands on the base of the bottom observations out of an underwater vehicle. The correlation between fish distribution, bottom relief, sediments and habitation depths was shown.

Gonzalez, F. and del Rio, J.L. 2004. Analysis of the Spanish catches of white hake (*Urophycis tenuis*) in NAFO Regulatory Area, 2000-2003. NAFO SCR documents 04/22: 9 p.

The Spanish fleet that operates in NAFO Regulatory Area has captured white hake in a regular way during the last years. Before 2002, the level of catches of this species has not been very high (300 tons per year) and these catches were part of the by-catch of the different fisheries that the Spanish fleet carries out in the NAFO Area (Greenland halibut *Reinhardtius hippoglossoides*, skates *Raja*, redfish *Sebastes*). Catches have been increased substantially in the last two years, having captured in the year 2003 more than 1 800 tons. The Spanish fishery directed to white hake *(Urophycis tenuis*) began in the year 2002 and it has been developed mainly in the Div. 3O among the depths 200-500 meters. The biggest catches are carried out during the third quarter, and more than 80% of the catches, in abundance and biomass, are mature.

Gonzalez, F. and Ramilo, G. 2001. Depth distribution of the effort, CPUE, proportion of mature and oversized in the catches of the Spanish fisheries in NAFO area. NAFO SCR documents 01/160: 14 p.

This paper reports an analysis of the depth distribution of effort and CPUE of the Spanish fleet, as well as undersized fish proportions and mature rates in the Spanish catches of five different species (Greenland halibut, American plaice, cod, yellowtail flounder, skate). Data were collected by the Spanish scientific observer program in the areas NAFO Div. 3LMNO during the period 1996-2000. More than 80% of the annual effort is carried out in the strata of 600-800, 800-1000 and >1000 meters. The species with highest yields in these strata is the Greenland halibut. 10% of the effort is carried out in the stratum of <200 meters and within this the highest yields correspond to skate and American plaice. The proportion of mature fish in the catches depends on depth for Greenland halibut and skate, whilst for the rest of the species the proportions of mature fish are bigger and more stable. The percentage of oversized fish is quite high, bigger than 95% in all species and ranges of depth.

Gonzalez, F., del Rio, J.L., Vazquez, A., Murua, H., and Román, E. 2003. Spanish research report for 2002. NAFO SCS documents 03/11: 26 p.

Gonzalez, F., del Rio, J.L., Vazquez, A., Murua, H., and Román, E. 2004. Spanish research report for 2003. NAFO SCS documents 04/9: 24 p.

Gonzales, F., Garcia, D., and Murua, H. 2004. Standardized CPUE indices for Greenland halibut in NAFO Divisions 3LMNO based on Spanish commercial catch rates. NAFO SCR documents 04/16: 7 p.

Standardized CPUE series using a Generalized Linear Model for Greenland halibut (*Reinhardtius hippoglossoides*) in Div. 3LMNO, based on catch and effort data from the Spanish trawl fleet since 1991 are presented. Fixed factors considered in the model were: year, month, vessel. Division and depth and the interactions analysed were: Division - depth and month - Division. All the factors and interactions analyzed are significant. The total proportion of variance explained by this model was 40%. The results indicate a decreased trend in the catch rate index in recent years from highest values in 2000

Gonzalez, F., del Rio, J.L., Vazquez, A., Murua, H., Román, E., Casey, J., Duran, P., and Ramilo, G. 2005. Spanish research report for 2004. NAFO SCS documents 05/8: 26 p.

Gonzalez Costas, F. and Gonzalez, D. 2005. Quality of the tuning series in the assessment of Greenland halibut Subarea 2 and Divisions 3KLMNO. NAFO SCR documents 05/37: 17 p.

The aim of this paper is to provide a deep study of the quality of the tuning series apply in the Greenland halibut assessment of the NAFO Subarea 2 and Divisions 3KLMNO, as well as to study the feasibility of including the Spanish 3NO survey as tuning fleet in future assessments of this stock. Our results may indicated that the Canadian autumn survey have a clear year effect in the 1995 data for ages older than 6 and that this could be due to the lowest depth coverage of the survey in 1995 compared to 1996-2003. Therefore, shortening the Canadian autumn survey index to 1996-2003 the fit of the data improve and, consequently, we propose to eliminate the 1995 data of this survey in the assessment. The Canadian spring survey showed a big trend in the log q errors of ages 7 and 8, so it could be convenient to study the possibility of shortening the age range of this tuning indices to ages 1 to 6. The study also showed that the fit of the Spanish 3NO survey is not very good for ages less than 5 years old, being the information given good for ages between 5 and 12 and, thus, it could be feasible to include this information in future assessments. The within, between surveys abundance correlations and the correlations between surveys and XSA abundance showed that surveys have many difficulties to track the ages 7, 8 and 9. This lack of tracking could be due related to age reading problems.

Gonzalez Troncoso, D. and Casas, J.M. 2005. Calculation of the calibration factors from the comparative experience between the R/V Cornide de Saavedra and the R/V Vizconde de Eza in Flemish Cap in 2003 and 2004. NAFO SCR documents 05/29: 8 p.

European Union (EU) carries out a stratified random summer bottom trawl survey in Flemish Cap, Div. 3M of the NAFO Regulatory Area, since 1988. Since 1991, the survey was made with the R/V Cornide de Saavedra. In 2003, this vessel was replaced for the R/V Vizconde de Eza, so, in order to maintain the series obtained from the old vessel, a two-year comparative fishing trial between the two vessels was made in the years 2003 and 2004. This work presents the methods used for the transformation of the series and their results for biomass and length distribution for the principal species in the area: Atlantic cod, American plaice, redfish (*Sebastes fasciatus, Sebastes marinus, Sebastes mentella* and *Sebastes* juveniles), Greenland halibut, Roughhead grenadier and Northern shrimp.For all the species except for Roughhead grenadier the R/V Vizconde de Eza is more efficient that the R/V Cornide de Saavedra for the biomass, with values of FPC varying between 1.0159 (Greenland halibut) and 1.4455 (juvenile redfish). In lengths, in all species except for roughhead grenadier too, the new vessel is more efficient catching the smallest individuals and less or equal efficient for the biggest lengths.

Gonzales Troncoso, D., Román, E., and Paz, X. 2002. Results for the Greenland halibut in the Spanish spring survey in the NAFO regulatory area of Divisions 3NO, 1996-2001: abundance, biomass and population structure. NAFO SCR documents 02/4: 12 p.

Since 1995, a stratified random spring bottom trawl survey in the NAFO Regulatory Area of Div. 3NO was conducted by Spain. The depth strata surveyed was extended to 1464 m. The main propose of the surveys was obtain abundance and biomass indices for the commercial species in the area. Following the recommendations of the 2000 Scientific Council Meeting, the entire series of abundance and biomass for American plaice are presented for the period 1995-2001. The indices calculated from the survey series shows a general increasing in the American plaice abundance and biomass in this period, and an important recruitment in the area in last years; this data suggest a recuperation of the stock.

Gonzales Troncoso, D., Román, E., and Paz, X. 2003. Transformed results for Greenland halibut from the surveys conducted by Spain in the NAFO regulatory area of Divisions 3NO, 1996-2002. NAFO SCR documents 03/8 (Rev.): 15 p.

Since 1995, a stratified random spring bottom trawl survey in the NAFO Regulatory Area of Div. 3NO was conducted by Spain. The depth strata surveyed was extended to 1464 m. The main propose of the surveys was obtain abundance and biomass indices and population structure for the commercial species in the area. In 2001, the trawl vessel was replaced in the realization of the trawls; so, the time series indices were transformed. The transformed entire series of abundance, biomass and length distribution for Greenland halibut are presented for the period 1996-2000, and the non-transformed data for the years 2001 and 2002. The standard deviations are shown for abundance and biomass. A decreasing in Greenland halibut biomass is observed in last years. A high percent of juvenile individuals shows a good recruitment in recent years.

Gonzales Troncoso, D., Román, E., and Paz, X. 2004. Results for Greenland halibut from the surveys conducted by Spain in the NAFO regulatory area of Divisions 3NO, 1996-2003. NAFO SCR documents 04/11: 15 p.

Since 1995, a stratified random spring bottom trawl survey in the NAFO Regulatory Area of Div. 3NO was conducted by Spain. In 2001, the trawl vessel was replaced in the realization of the trawls; so, the time series indices were transformed. The transformed entire series of mean catches, abundance, biomass and length distribution for Greenland halibut are presented for the period 1996-2000, and the non-transformed data for the years 2001-2003. The standard deviations are shown for abundance and biomass. The summed abundance and biomass based on conversion of the length frequencies are presented and compared to the estimates from the method used to convert the CPUE. A decreasing in Greenland halibut biomass and abundance is observed in last years (2000-2003). A high percent of juvenile individuals could indicate a good recruitment in recent years.

Gonzales Troncoso, D., Román, E., and Paz, X. 2005. Results for the Greenland halibut of the Spanish survey in NAFO Divisions 3NO : biomass, length distribution and age distribution for the period 1997-2004. NAFO SCR documents 05/27: 18 p.

Greenland halibut (*Reinhardtius hippoglossoides*) indices from the bottom trawl survey that Spain carries out in spring since 1995 in Divisions 3NO of the NAFO Regulatory Area are presented. Biomass, length and age distribution are presented since 1997, year in that the survey extends the depth strata. In 2001, the R/V Vizconde de Eza replaced the C/V Playa de Menduíña in the realization of the survey. We present the transformed to the R/V Vizconde de Eza series for the period 1997-2000, and the original obtained data for the period 2002-2004. In 2001, there are data from the two vessels. This species presents a decreasing trend along the period. It seems not to be recuperation of the

Gorchinsky, K.V. 1993. Results from Greenland halibut assessment in Divisions 0B, 2GH by the data from 1992 trawl survey. NAFO SCR documents 93/15: 7 p.

Greenland halibut stocks in Divs. 0B, 2GH are still remaining at a stable low level. Due to heavy ice conditions in autumn 1992 the trawl survey has covered only about 40% of Div.0B, surveyed in 1991. Greenland halibut abundance made up 37.5 mill.spec. and biomass - 31.7 thou.t, which corresponded to the level of 1987. The area investigated in Divs.2GH was 50% lower compared to a previous year. Halibut stock constituted 22.4 mill.spec. or 14.5 thou.t. This estimate is close to that for 1991.

Gorchinsky, K.V. 1996. Assessment of Greenland halibut abundance and biomass in the northern part of the Flemish Pass by data of a Russian trawl survey in February 1996. NAFO SCR documents 96/72: 5 p.

Because of the stock decrease and introduction of a temporal ban for catch of main commercial fish species inhabiting the 200-mile zone of Canada, a great attention is recently paid to fish concentrating outside the zone. Since the 1990's, fishery for Greenland halibut has been successfully developed in the NAFO zone on the continental slope of the Grand Bank of Newfoundland, as well as on the western slope of the Flemish Cap. In accordance with the estimation of experts, Greenland halibut catch of all countries in this area reached in some years 50-60 thou. t. Since the populational structure and dynamics are poorly studied, it is impossible to prove TAC. Results of a trawl survey for Greenland halibut and specific features of the species distribution in the northern part of the Flemish Pass, as well as fish lengths by strata are presented in the paper.

Gorchinsky, K.V. 1997. Spatial and temporal variations in Greenland halibut females ratio at age in NAFO Divisions 0B, 2GH and 3LM. NAFO SCR documents 97/27: 10 p.

Since the 1960s Greenland halibut (*Reinhardtius hippoglossoides*) has been an object of a directed fishery in the Northwest Atlantic. Despite the fact that this species has a wide distribution from Davis Strait to Georges Bank an intensive fishery took place, as a rule, in the same areas. With a decrease in catches taken in traditional fishing grounds the fishery shifted to greater depths and to new areas. Since the 1990s the main portion of halibut catch has been taken in NAFO Regulatory area, mainly off the Flemish Pass at depths to 1800m. Fish adaptation to the impact of the fishery and to environmental conditions over an area can take different forms. Differences between males and females, fishing gear selectivity, seasonal variations, can influence stock assessment. In this case, biological peculiarities of Greenland halibut, such as variation in length composition of fish in aggregations by depth, sex separation on spawning grounds, should be considered. The aim of this paper is to estimate differences in sex ratio of Greenland halibut (according to relative number of females) during the period 1984-1992 in Divs. 0B, 2GH, 3K and from 1993 to 1996 -- in Divs. 3LM.

Gorchinsky, K.V. 1998. Spatial and temporal variations in Greenland halibut (*Reinhardtius hippoglossoides*) sex ratio-at-age in NAFO Divisions 0B, 2GH, 3K and 3LM. Northwest Atl. Fish. Organ. Sci. Counc. Stud. 31: 73-78.

Greenland halibut (*Reinhardtius hippoglossoides*) sex ratio is subjected to spatial and year-to-year variations. Based on data collected from USSR/Russian trawl surveys for the Greenland halibut in NAFO Div. 0B, 2GH, 3K and 3LM during 1984-96, the proportion of females were found to gradually increase from the northern divisions to the southern ones. As a rule, males were predominant in catches taken in the more northern Div. 0B, 2GH and females in Div. 3K and 3LM. From 1984 to 1992 the proportion of females successively decreased in Div. 3K. With the increase of age of the Greenland halibut, the proportion of males decreased, at an earlier age in the southern divisions compared to the northern ones. In Div. 0B, all specimens above age 13 were females; males above age 11 disappeared from catches in Div. 3K and 3LM.

Gorchinsky, K.V. 2000. Age-length composition of commercial catches of Greenland halibut from Division 1D in September-October, 1999. NAFO SCR documents 00/7: 7 p.

Data on biology of Greenland halibut (*Reinhardtius hippoglossoides)* from commercial catches in the area of West Greenland (1D) are presented in this paper. Biological data was collected by a scientific observer on board the fishing vessel MI-0297 "Maroanjoca" in September/October, 1999. Fishing was carried out at a depth of 900-1500 m. Fishing gear used was a bottom trawl with 140 mm mesh size. Males 26-73 cm long were registered in catches, the mean length constituted 47.2 cm. Female length varied from 34 to 104 cm, mean length constituted 50.9 cm. Age composition of commercial concentrations of halibut are presented by specimens from age 4-19; fish from 1990-1993 year classes dominated catches. At all surveyed depths, males dominated catches, and sex ratio constituted 3.7:1.

Gorchinsky, K.V. 2001. Bathymetrical distribution of American plaice by-catches in the directed fishery for Greenland halibut, thorny skate and beaked redfish in NAFO Divisions 3LMNO in January-July 2000. NAFO SCR documents 01/18: 6 p.

By catch of American plaice (*Hippoglossoides platessoides*) in the directed fishery for Greenland halibut *(Reinhardtius hippoglossoides*), averaged by months and 100-m depth range, varied from 0 to 5.1%. In Div. 3LM, with a depth increase from 600 to 1399 m, by catches tended to decline. In Div. 3NO, American plaice by catches generally declined from 0 to 599 m depth and increased from 600 m and deeper. The largest individuals were observed in the southern Grand Bank to 200 m depth where female length reached 65-69 cm.

Gorchinsky, K.V. and Savvatimsky, P.I. 1994. Composition of bottom trawl catches at different depths off the Flemish Pass in 1989-1993. NAFO SCR documents 96/39: 6 p.

Analysis for Russian bottom trawl catches taken at 100-800 m depths in May-July 1989-1993 and in September-October 1991-1993 indicated a minor portion of halibut to be 11% and that of Sebastes marinus - 51.8% up to 800 m depth. Skate constituted 26.8% from catches taken at 201-300 m depths. Greenland halibut (*Reinhardtius hippoglossoides*) below 50 cm long from the depths above 901-1000 m and Sebastes mentella of 30 cm long up to 800 m depth were predominant in catches. Mean length of these fish species grew with an increase in fishing depth.

Gorchinsky, K.V. and Vaskov, A.A. 1992. Trawl survey on Greenland halibut stock evaluation in NAFO Divs. 0B and 2GH in October/December 1991. NAFO SCR documents 92/22: 15 p.

Gordon, J.D.M. 2001. Deep-water fisheries at the Atlantic Frontier. Cont. Shelf Res. 21: 987-1003.

The deep sea is often thought of as a cold, dark and uniform environment with a low-fish biomass, much of which is highly adapted for life in a food-poor environment. While this might be true of the pelagic fish living in the water column, it is certainly not true of the demersal fish which live on or close to the bottom on the continental slopes around the British isles (the Atlantic Frontier). These fish are currently being commercially exploited. There is growing evidence to support the view that success of the demersal fish assemblages depends on the pelagic or benthopelagic food sources that impinge both vertically and horizontally onto the slope. There are several quite separate and distinct deep-water fisheries on the Atlantic Frontier. It is a physical barrier, the Wyville-Thomson Ridge, which results in the most significant division of the fisheries. The Ridge, which has a minimum depth of about 500 m, separates the warmer deep Atlantic waters from the much colder Norwegian Sea water and as a result, the deep-water fisheries to the west of the Hebrides and around the offshore banks are quite different from those of the Faroe-Shetland Channel (West of Shetland). The fisheries to the West of the Hebrides can be further divided by the fishing method used into bottom trawl, semipelagic trawl and longline. The bottom-trawl fisheries extend from the shelf-slope break down to about 1700 m and the target species varies with depth. The smallest vessels in the fleet fish on the upper slope, where an important target species is the anglerfish or monkfish (*Lophius* spp.). On the mid-slope the main target species are blue ling (*Molva dypterygia*) and roundnose grenadier (*Coryphaenoides rupestris*), with bycatches of black scabbardfish (*Aphanopus carbo*) and deep-water sharks. On the lower slope orange roughly *(Hoplostethus atlanticus)* is an important target species. The major semipelagic trawl fishery is a seasonal fishery on spawning aggregations of blue whiting (*Micromesistius poutassou*). The other semipelagic fishery is on spawning aggregations of the greater silver smelt or argentine (*Argentina silus*). Spanish and UK vessels that target mainly hake (*Merluccius merluccius*) and a Norwegian fleet that targets ling (*Molva molva*), blue ling and tusk (*Brosme brosme*) dominate the upper slope longline fishery. West of Shetland, the fishery on the upper slope has some similarities with that of the Hebridean slope, with anglerfish and blue ling being important target species. A quite different fishery occurs in the transition zone between the Atlantic and Norwegian Sea waters. Here the main target species is Greenland halibut (*Reinhardtius hippoglossoides)*. Below the transition zone biomass decreases rapidly and there is no fishery. It is generally agreed that many deep-water species have slow growth, a high age at first maturity and a low fecundity, which makes them vulnerable to over-exploitation. Other features of these fishes such as high mortality of discards and escapees will add to the problems. Despite this the only management procedures in place are general limitation of effort measures within the area of jurisdiction of the European Union.

Gordon, J.D.M. 2001. Open ocean fisheries for deep-water species. Encyclopedia of Ocean Sciences. v. 4: 2023-2030

Deep-water fisheries are considered to be those that exploit fish or shellfish that habitually live at depths greater than 400 m. With the exception of some localized line fisheries around oceanic islands, such as for *Aphanopus carbo* (black scabbardfish) at Madeira in the Atlantic and for *Ruvettus* in Polynesia, the fisheries are mostly of recent origin. The deep-water fisheries of the continental slopes only developed in the 1960s when Soviet trawlers discovered and exploited concentrations of roundnose grenadier (*Coryphaenoides rupestris)* off Canada and Greenland. At the same time, the Soviet fleet was exploiting similar resources in the North Pacific. Since then, despite a decline in Russian landings, deep-water fisheries have continued to expand on a global scale. Some of these fisheries target species that had never previously been exploited, such as orange roughy (*Hoplostethus atlanticus*). Some species have a depth range that extends from the shallow continental shelf depths into deeper water, and there is an increasing trend for the fisheries on these species to extend into deeper water and exploit all stages of the life history. Examples of such species in the North Atlantic are Greenland halibut (*Reinhardtius hippoglossoides*), anglerfish (*Lophius* spp.) and deep-water redfish (*Sebastes mentella*)

Gouteux, B., Lebeuf, M., Trottier, S., and Gagne, J.P. 2002. Analysis of six relevant toxaphene congeners in biological samples using ion trap MS/MS. Chemosphere 49: 183-191.

Six polychlorinated bornanes (CHBs) was quantified in *Microgadus tomcod, Reinhardtius hippoglossoides, Delphinapterus leucas, Halichoerus grypus, Gadus morhua* and *Glopbicephala* using ion trap MS/MS. The significance of the selection of parent ions (Ip) and daughter ions (Id) on the detection of these toxaphene congeners was assessed in standard solution and biological samples. Our results indicate that different Ip and Id, selected at either low or high mass-to-charge (m/z) ratios, influence drastically the response factor of the CHBs and the chemical noise observed. For the octachlorinated toxaphene congeners (Parlar-26 (P-26), Parlar-40/41 (P-40/41), Parlar-44 (P-44)), the detection performance of the ion trap MS/MS is similar whether Ip and Id were chosen at low or high m/z ratios. However, the selection of Ip and Id at high m/z ratios clearly enhances the detection of the nonachlorinated toxaphene congeners (Parlar-50 (P-50), Parlar-62 (P-62)). The improved method, which selects Ip and Id at low m/z ratios for P-26, P-40/41 and P-44 and at high m/z ratios for P-50 and P-62, permitted to obtain low detection limits as well as repeatable and accurate results.

Greenland. Namminersornerullutik Oqartussat. Danmarkskontoret 1988. Denmark (Greenland) request for scientific advice on management of certain stocks in 1988. NAFO SCS documents 88/04: 1 p.

Gundersen, A.C. 2002. Note on fecundity of Greenland halibut in West-Greenland waters. *In* Reproduction of West-Nordic Greenland Halibut. Studies reflecting on maturity, fecundity, spawning and TEP, *Edited by* A.C.Gundersen. Nordic Council of Ministers, Copenhagen (Denmark). pp. 197-210.

Fecundity is defined as the number of egg produced, for the upcoming spawning season. In some cases fecundity may act compensatory in response to varying stock size. Some species have shown a capacity of increasing oocyte production in times of reduced spawning stock (e.g. Bagenal, 1973). The possible compensatory effect of fecundity to spawning stock size, different exploitation levels of the various areas, and possible geographic effects of different Greenland halibut stocks, make it difficult to use the same estimate of fecundity in all areas and also to use estimates for previous years. Several investigations on Greenland halibut fecundity are reported. The studies cover West Greenland (Jensen, 1935), East Greenland (Gundersen et al., 2001), Barents Sea (Millinsky, 1944; Gundersen et al., 1999; 2000), Southern Labrador Sea (Liar, 1970), Iceland (Magnusson, 1977), Bering Sea (D'yakov, 1978), Southern Labrador and Gulf of St. Lawrence (Flowering, 1980), and the Davis Strait near Labrador (Serebryakov et al., 1992).

Gundersen, A. C. 2002. Reproduction of West-Nordic Greenland halibut: studies reflecting on maturity, fecundity, spawning and TEP. TemaNord; 2002:519. 323 p.

Greenland halibut (*Reinhardtius hippoglossoides*) in the waters of East Greenland, Iceland and Faroe Islands (West-Nordic Greenland halibut) constitutes a separate management unit in the ICES management system. The objective of the project "Maturity and fecundity of West-Nordic Greenland halibut" has been to increase the understanding of reproductive biology of the species. The project has focused on the process of gonad maturation, oocyte development, onset and occurrence of atresia, spawning, fecundity, and total egg production (TEP). Studies on Greenland halibut in adjacent areas such as West-Greenland and Hatton Bank were included in parts of the project. Studies were conducted based on biological samples collected during ongoing surveys. Ovaries in all maturity stages were observed. Atretic oocytes were not found in immature gonads, but were observed in 60-70% of the gonads of sexually maturing and mature specimens. Relations between fecundity and length have been estimated for all areas. The estimated fecundity--length relationships for East-Greenland served as a basis for estimating TEP of the stock. Spawning in East-Greenland waters was reported during joint Norwegian Greenland surveys. Detailed descriptions of the methods used in the laboratory analyses are included in the report, comprising, how to embed Greenland halibut ovarian tissue in Technivit registered, various staining techniques, and how to prepare fecundity estimates.

Gundersen, A.C. 2003. Sexual maturity, fecundity and nursery grounds of northeast Arctic Greenland halibut (*Reinhardtius hippoglossoides* (Walbaum)). University of Bergen, Bergen (Norway). Thesis (Ph.D.) University of Bergen, Norway. 1 v.

Gundersen, A.C. and Brodie, W.B. 1999. Length-weight relationships for Greenland halibut (*Reinhardtius hippoglossoides*) in NAFO Divisions 2GHJ and 3KLMNO, 1990-1997. NAFO SCR documents 99/31: 21 p.

Based on data from the annual Canadian fall surveys, length-weight relationships of Greenland halibut (*Reinhardtius hippoglossoides*) were estimated for NAFO Divisions 2GHJ and 3KLMNO for the years 1990-1997. the relationship between length and weight varied between different areas within one year. and also between years. The estimated weight for a 50 cm Greenland halibut varied over the time period investigated. The overall trend in all divisions is a decrease in estimated round weight until 1995, followed by an increase in round weight in 1996, stabilizing in 1997.

Gundersen, A.C. and Emblem, W.M. 2002. Method for fecundity studies on Greenland halibut. *In* Reproduction of West-Nordic Greenland halibut. Studies relfecting on maturity, fecundity, spawning and TEP. *Edited by* A.C.Gundersen. Nordic Council of Ministers, Copenhagen (Denmark). pp. 307-322.

This report gives a description of the method used for estimating fecundity of Greenland halibut, based on the investigations conducted by Gundersen *et al.* (1999; 2000; 2001). The aim of the report is to give a detailed description of the different steps in the sampling and laboratory procedures and to throw light on problems that may arise during the study.

Gundersen, A.C. and Hjörleifsson, E. 2002. Fecundity of Greenland halibut (*Reinhardtius hippoglossoides* W.) in the waters of Iceland. *In* Reproduction of West-Nordic Greenland Halibut. Studies reflecting on maturity, fecundity, spawning and TEP. *Edited by* A.C.Gundersen. Nordic Council of Ministers, Copenhagen (Denmark). pp. 151-169.

Potential fecundity was in the range of 8000 to 152,000 oocytes for fish ranging in size from 57 to 99. The relationship that describes fecundity as a function of length is F = 1.942/10 super(6)/L super(3.93). Fecundity is given in 1000. Gonadosomatic index was mainly in the range 1-8% with one high value of 13%. This indicates that females were maturing. Hepatosomatic index was mainly in the range 0.6--3.5% with one observation of about 4.4%. There was observed signs of increase in liver index with respect to increased total length. The Icelandic relationship was in the same range as what is observed in the Barents Sea in the late 1990s. Icelandic Greenland halibut seem to produce fewer eggs than Greenland halibut in East Greenland, and more eggs than Greenland halibut in Faroe Islands and West Greenland. The observations presented by Magnusson (1977), were lower than observations made in our study. The order of magnitude of the 1977-observations is close to results from East Greenland in 1999, when sampling was overlapping with spawning.

Gundersen, A.C. and Høines, Å. 2003. Norwegian fishery for Greenland halibut, grenadiers and redfish in West-Greenland waters, 2001-2002. NAFO SCR documents 03/33: 7 p.

This research document contains information on landing statistics and catch composition of Greenland halibut in West-Greenland waters during 2002. Information covers length measurements for both years indicating catch composition form the trawl fishery. For 2002 information on sex composition, maturity, age and length weight is available.

Gundersen, A.C., Hareide, N.-R., Berg, V., and Pedersen, S.A. 1994. A trial longline fishery for Greenland halibut (*Reinhardtius hippoglossoides*) in the northern Davis Strait, August 1993. NAFO SCR documents 94/10: 11 p.

A trial longline fishery with the Norwegian vessel M/S "Skarheim" was conducted in the northern Davis Strait in August 1993. The purpose of the fishery was to collect biological information on the commercial fish species, in particular Greenland halibut (*Reinhardtius hippoglossoides)* in order to evaluate the potential for a commercial longline fishery. The highest Greenland halibut catch rates of 153-260 kg per 1000 hooks were obtained at depths between 800-1200 m at three fishing localities, 2-4 in NAFO Subarea 1A and in water with temperatures above about 0.5 deg C. Greenland halibut was caught in all investigated depth strata. The depth distribution of the catch rates in Subarea 1A indicates that depths between 800-1000 m may be best suited for a commercial fishery on Greenland halibut. Below 1000 m, large numbers of Arctic skates were taken in some of the settings. The size distributions of Greenland halibut in the catches were in the size range of 35- 100 cm total length with the majority being from 45-75 cm. The mean length of Greenland halibut in the catches showed a weak increasing trend with depth down to about 1200 m. In depth stratum 800-1000 m the mean length of Greenland halibut in the catches decreased slightly with increasing latitude. Due to drifting west ice no longline settings could be made on the continental slope below 1400 m. Therefore, no final conclusions concerning the catch rates of Greenland halibut in relation to fishing depth could be drawn.

Gundersen, A.C., Boje, J., and Woll, A.K. 1997. Greenland halibut (*Reinhardtius hippoglossoides* Walbaum) in East-Greenland waters. Longline survey in ICES Division XIVb, July-August 1996. ICES CM 1997/BB:05: 12 p.

A joint Norwegian-Greenlandic longline survey was carried out in ICES Division XIVb in July-August 1996. Three localities were investigated, covering the plateau below the continental slope: A) south of Kap Mesting Ground (63 degree l0N-39 degree 35W), B) north of Kap Bille Bank (62 degree l0N-40 degree 12W), and C) east of Walloee Bank (60 degree 08N- 41 degree SSW). The localities A and C were had previously not been exploited, whereas a commercial trawl and longline fishery was going on in locality B. Bottom temperature was 3-4 degree C. The main catch was Greenland halibut (*Reinhardtius hippoglossides*), whereas the bycatch consisted mainly of Roughead grenadier (*Macrourus berglax*) and Finescale antimora (*Antimora rostrata).* The yield of Greenland halibut, expressed as catch (kg) per 1000 hooks, was high in the exploited locality B with an average of 438.7kg/1000 hooks, and low in the unexploited localities (163.6kg/1000 hooks in locality A and 136.8kg/1000 hooks in locality C). The yield of bycatch showed an inverse pattern, beeing high in locality A and C and low in locality B.

Greenland halibut was smaller in the commercial locality B (mean length 75.8 cm) than in the new localities (mean lengths 86.3 cm and 79.6 cm in locality A and C respectively). This paper summarizes the results of the longline survey with focuse on the catch composition and biology of Greenland halibut. A comparison of the unexploited localities and an exploited locality, may lead to important information about the impact of exploitation on the Greenland halibut stock and on a commerciat fishing ground in ICES Division XIVb.

Gundersen, A.C., Kjesbu, O.S., Stene, A., and Nedreaas, K.H. 1998. Fecundity of Northeast Arctic Greenland halibut (*Reinhardtius hippoglossoides).* NAFO SCR documents 98/107: 9 p.

Relations between fecundity and length (cm) and fecundity and weight (g) were established for Greenland halibut (*Reinhardtius hippoglossoides*) in the North East Arctic, based on a total of 95 ovaries collected near Bear Island, Barents Sea, in September 1996. Fecundity ranged from 6 800 to 70 500 eggs per female. The Greenland halibut were mainly in maturity stage 4, which is by definition, vitellogenic oocyte size between 2 and 4 mm in diameter. Mean gonadosomatic index was 7.5% (range 2.0-13.5%). Because of recruitment failures and a historic low spawning stock biomass, the Northeast Arctic Greenland halibut has been strongly regulated in the 1990s. Fecundity, which is defined as the number of vitellogenetic oocytes developing in each female prior to the spawning season, is important for understanding spawning-stock recruitment relationships. The relation between fecundity and length for Northeast Arctic Greenland halibut stock has not been previously established.

Gundersen, A.C., Kjesbu, O.S., Stene, A., and Nedreaas, K.H. 1998. Fecundity of Greenland halibut (*Reinhardtius hippoglossoides*) in the north east Arctic. ICES CM 1998/O:29:16 p.

Because of recruitment failures and a historic low spawning stock biomass, the Northeast Arctic Greenland halibut (*Reinhardtius hippoglossoides*) stock has been strongly regulated in the 1990s. Fecundity, which is defined as the number of vitellogenetic oocytes developing in each female prior to the spawning season, is important for understanding spawning-stock-recruitment relationships. The relation between the fecundity and length for Northeast Arctic Greenland halibut stock has not been previously established. A total of 95 Greenland halibut ovaries, collected in September 1996 in the Norwegian and Barents Sea were analysed. The Greenland halibut were mainly in maturity stage 4, that is vitellogenic oocyte size between 2 and 4 mm in diameter. The estimated mean gonadosomatic index (GSI) was 7.5 % (range 2.0-13.5 %). Fecundity ranged from 6,800 to 70,500 eggs per female. The fecundity-length (F (in 1000)-L (in cm)) relationship is: F = 1.155 times 10 super(-7) times L super(4.598) (r super(2)= 0,68). The fecundity-weight (F (in 1000) -W (in g)) relationship is: F = 2.539 times 10 super(-4) times W super(1.439) (r super(2)=0.77).

Gundersen, A.C., Kjesbu, O.S., Nedreaas, K.H., and Stene, A. 1999. Fecundity of Northeast Arctic Greenland halibut (*Reinhardtius hippoglossoides*). J. Northwest Atl. Fish. Sci. 25: 29-36.

Relationships between fecundity (thousands) and total length (cm), F=1.155X10-7XL4.598 and fecundity (thousands) and round weight (g) (F=2.539X10-4XW1.439) were established for Greenland halibut in the Northeast Atlantic, based on a total of 95 ovaries collected near the Bear Island in the Barents Sea, in September 1996. The potential fecundity ranged from 6 800 to 70 500 eggs per female. The Greenland halibut were in the total length range 48-80 cm. The Greenland halibut were maturing with ovaries containing vitellogenic oocyte sized about 2-4 mm in diameter, visual to the naked eye.

Gundersen, A.C., Nedreaas, K.H., Kjesbu, O.S., and Albert, O.T. 2000. Fecundity and recruitment variability of Northeast Arctic Greenland halibut during 1980-1998, with emphasis on 1996-1998. J. Sea Res. 44: 45-54.

Because of indications of recruitment failures and a historic low spawning stock, the Northeast Arctic Greenland halibut (*Reinhardtius hippoglossoides* Walbaum) stock has been strongly regulated in the 1990s. Fecundity is a link between the spawning stock and the following recruitment. This paper describes relationships between fecundity and total length for Northeast Arctic Greenland halibut for 1997 and 1998, based on samples taken in autumn on the continental slope west of the Barents Sea. A previous study describes a similar relationship for 1996. Individual fecundity is raised to a population level using stock data from XSA, and sex composition data, maturity oogives, and mean length at age from surveys covering the area of distribution. Total egg production (TEP) varied slightly around 1.0 x 10 super(11), during 1996-1998, with the highest TEP in 1998. A back-calculating exercise estimated annual TEP during 1980-1998 in the range 0.9-3.4 x 10 super(11), and revealed that age groups 9-12 were the main contributors to TEP.

Gundersen, A.C., Boje, J., Jørgensen, O.A., Hjörleifsson, E., Simonsen, C.S., Fossen, I., Ofstad, L.H., and Rätz, H.J. 2001. Variability in fecundity and total egg production for West-Nordic Greenland halibut. NAFO SCR documents 01/157: 3 p.

The West-Nordic stock of Greenland halibut (*Reinhardtius hipploglossoides*) comprises Greenland halibut distributed in the waters of East Greenland, Iceland and Faeroe Islands. Stock dynamics, reproduction and recruitment for this stock are poorly described. Fecundity may be an important contribution in the understanding of spawning-stock - recruitment relationships. Changes in fecundity may contribute to recruitment variability, and fecundity is for some species described to act compensatory with a response to stock size. Fecundity-length-relationship has been published for Greenland halibut in East Greenland waters for 1997. The present paper presents fecundity - length relationships for Greenland halibut in East Greenland for the years 1998-2000. Relationships for 1997-2000 are compared to study possible annual variations. The relationships are compiled and raised to population level to study possible relationships between spawning stock size and recruitment as obtained from the XSA.

Gundersen, A.C., Kjesbu, O.S., Nedreaas, K.H., and Albert, O.T. 2001. Maturity of Northeast Arctic Greenland halibut (*Reinhardtius hipploglossoides*). NAFO SCR documents 01/158: 7 p.

The maturity cycle of Northeast Arctic Greenland halibut (*Reinhardtius hippolglossoides*) was studied on two locations in the spawning area, in the continental slope of northern Norway. Ovaries were collected once a month throughout 1997. Samples from ovaries were mounted in Technovit registered . Sections were studied in the microscope, aiming to describe the maturity process throughout the year. Together with diameter measurements of oocytes from each month and field observations of Greenland halibut females, the study has increased the knowledge about the maturity process of Northeast Arctic Greenland halibut females. Measurements of oocyte diameter show a pattern that supports the hypothesis about peak spawning in November - January. After spawning in January and February, oocyte distribution was uniform with a peak between 500 and 900 micrometers. In March-April a peak of oocytes was separated from the early maturing oocytes and this peak grew steadily until spawning. In August this peak was found between 1 700 and 2 200 micrometers. In October-November the peak was between 2 400 and 2 700 microns. The maturity process of the oocytes is described through histological analyses, which also are used to study extent of atretic oocytes during the maturity cycle.

Gundersen, A.C., Roenneberg, J.E., and Boje, J. 2001. Fecundity of Greenland halibut (*Reinhardtius hippoglossoides* Walbaum) in East Greenland waters. Fish. Res. 51: pp-236.

Fecundity is described for Greenland halibut, based on ovaries collected in July 1997 in ICES Division XIVb in East Greenland waters. The mean potential fecundity was estimated to be 113 700 (range 32 500-277 100). Fecundity was significantly determined by total length. Fecundity-length and fecundity-weight (round and gutted) relationships were estimated. Vitellogenic oocytes appearing dark in the microscope with a diameter ranging from 900 to 1650 mu m were counted and used in the fecundity estimates. This stage was easily distinguished from an early vitellogenic stage, with a diameter ranging from 490 to 1050 mu m (mean 730 mu m). The latter appeared transparent with a small brownish nucleus.

Gundersen, A.C., Rønneberg, J.E., and Boje, J. 2001. Fecundity of Greenland halibut (*Reinhardtius hippoglossoides* Walbaum) in East Greenland waters. Fish. Res. 51: 229-236.

Fecundity is described for Greenland halibut, based on ovaries collected in July 1997 in ICES Division XIVb in East Greenland waters. The mean potential fecundity was estimated to be 113 700 (range 32 500-277 100). Fecundity was significantly determined by total length. Fecundity-length and fecundity-weight (round and gutted) relationships were estimated. Vitellogenic oocytes appearing dark in the microscope with a diameter ranging from 900 to 1650 mum were counted and used in the fecundity estimates. This stage was easily distinguished from an early vitellogenic stage, with a diameter ranging from 490 to 1050 mum (mean 730 mum). The latter appeared transparent with a small brownish nucleus.

Gundersen, A.C., Woll, A.K., and Fossen, I. 2001. Spawning of Greenland halibut in east Greenland waters. NAFO SCR documents 01/167: 3 p.

Spawning Greenland halibut was observed during two joint Norwegian-Greenland surveys in East Greenland waters. During a gillnet survey conducted in 1995 at Kap Bille Bank and Fylkir Bank several females were reported to be spawning at 1200-1400 m depths. During a longline survey at Kap Bille Bank in August 2000 one running female and two running males were observed. Greenland halibut have not been reported to spawn in this area before. The spawning female observed in 2000 had oocytes in diameter in the range and the oocytes were floating freely in the ovary, and were floating out on the measuring board when the ovary was opened.

Gundersen, A.C., Boje, J., Jørgensen, O.A., Hjörleifsson, E., Simonsen, C.S., Fossen, I., Ofstad, L.H., and Rätz, H.J. 2002. Variability in fecundity and total egg production for West-Nordic Greenland halibut. *In* Reproduction of West-Nordic Greenland halibut. Studies reflecting on maturity, fecundity, spawning and TEP. *Edited by* A.C.Gundersen. Nordic Council fo Ministers, Copenhagen (Denmark). pp. 211-242.

TEP was in the 2-6/10 super(11) - 8.4/10 super(11) per year using a high production scenario, and 2.3/10 super(11) - 7.4/10 super(11) per year using the low production scenario. This is slightly lower than what was found for Greenland halibut in the Davis Strait, off Labrador and off West Greenland and slightly higher than estimated for the Barents Sea. Age groups 10-14 were the most important contributor to TEP, contributing to 50-88% of total TEP. The re-estimated spawning stock in numbers (SSN) appeared slightly different than the SSB obtained from the XSA. Since 1988, SSN showed a lesser variability than SSB. SSN includes the maturing females only, and this may explain the variability. The survival index gives was in the range 0.0026-0.0099 using the high scenario (FL-relationship for 1997-1998) and in the range 0.0030-0.0112 using the low scenario (FL-relationship for 2000). The lower values of the high scenario are in the same range as observed for Greenland halibut in the Barents and in the in the Davis Strait, off Labrador and off West Greenland. TEP increased throughout the period whereas survival decreases, implying the presence of density-dependent mechanisms.

Gundersen, A.C., Emblem, W.M., Hellevik, A.H., Roenneberg, J.E., and Boje, J. 2002. Fecundity of Greenland halibut (*Reinhardtius hippoglossoides*) in East-Greenland waters 1997-2000. *In* Reproduction of West-Nordic Greenland Halibut. Studies reflecting on maturity, fecundity, spawning and TEP. *Edited by* A.C.Gundersen. Nordic Council of Ministers. Copenhagen (Denmark). pp. 117-149.

This report describes fecundity studies for Greenland halibut during 1997-2000. Samples were collected during joint Norwegian--Greenlandic surveys and from German factory trawlers. Relationships for 1997-2000 are compared, to study possible annual variation. Ovaries analyzed contained recruiting oocytes (rudiments), in addition to vitellogenic oocytes in 2 maturity stages. Fully vitellogenic oocytes (G1) that will be spawned in the next spawning season were counted and used in the analyses. Early vitellogenic oocytes (G2) were significantly smaller than G1 and appeared brighter in the binocular. Individual potential fecundity varied between 9,400 and 277,000 oocytes per female. Comparisons of potential fecundity indicated variability in length-based fecundity from one year to another. Fecundity estimates for 1997 and 1998 were in the same range. In 2000 length-based fecundity indicated a lower potential fecundity than in 1997 and 1998. Fecundity estimates for 1999 were different from the other years. We concluded that the samples collected in March 1999 actually was late maturing females in the same maturity cycle as from which we had taken samples during August 1998. GSI in 1999 was in general high for the ovaries analyzed, with the highest value of 24%). This indicates overlap with spawning or that spawning will occur shortly. The samples from 1999 indicate spawning to occur in East Greenland waters during March, or at least during February--April.

Gundersen, A.C., Emblem, W.M., Hellevik, A.H., Steingrund, P., and Ofstad, L.H. 2002. Fecundity of Greenland halibut (*Reinhardtius hippoglossoides*) in Faroese waters, summer 1999. *In* Reproduction of West-Nordic Greenland halibut. Studies reflecting on maturity, fecundity, spawning and TEP. *Edited by* A.C.Gundersen. Nordic Council of Ministers, Copenhagen (Denmark) p. 175-196.

The ovaries contained rudiments and oocytes in two developmental stages. The developmental stages are described below. Fecundity varied between 10,000 and 77,400 oocytes. Females with the highest fecundity were 67 cm and 75 cm. Average fecundity for the whole material was 36,000 oocytes. The fecundity varied between fishes in the same length group. The relation between length (L) and fecundity (F) was estimated as: F=2.35/10 super(6)/L super(3.838). Compared to other areas, Greenland halibuts in the waters of Faroe Islands had fecundities in the same magnitude as observed for Greenland halibut in Southern Labrador (Bowering 1980), New Foundland--Labrador (Lear, 1970; Serebryakov et al., 1992), and in the Barents Sea (Gundersen et al. 1999, 2000). Fecundity is below the calculated fecundity for Greenland halibut in EastGreenland waters (Gundersen et al., 2001)

Gundersen, A.C., Woll, A.K., and Fossen, I. 2002. Spawning of Greenland halibut in East Greenland waters. *In* Reproduction of West-Nordic Greenland halibut. Studies reflecting on maturity, fecundity, spawning and TEP. *Edited by* A.C.Gundersen. Nordic Council of Ministers, Copenhagen (Denmark). pp. 243-260.

Gillnet catches (1995) consisted of Greenland halibut in the total length range 36-117 cm. 3947 were sexed of which 93.4% were females. Of the sexed material (N = 589) 64.3% of the females were maturing and 10% of the females were running at the time of sampling. Running females were in the length range 58-110 cm (ST = 12.5, N = 59). No running males were observed. From long line catches (2000), 1129 Greenland halibut females and 74 males were classified for maturity at the Kap Bille Banke one female and two males were running at the time of sampling. Oocytes in the running female were hydrated and floated freely in the ovary. Oocyte diameter was found to be in the range 3.40-5.04 mm after preservation in 3.6% buffered formaldehyde. Mean oocyte diameter was 3.85 mm.

Gundersen, A. C., Hjörleifsson, E., and Siegstad, H. 2004. Greenland halibut in the waters of East Greenland, Iceland and Faroe Islands. *In* Management strategies for commercial marine species in northern ecosystems: proceedings of the 10th Norwegian-Russian Symposium Bergen, Norway 27-29 August 2003 ,*Edited by* Bjordal, Å., Gjøsaeter, H., and Mehl, S. IMR/PINRO Joint Report Series; 1: pp. 81-93.

In recent years, the Greenland halibut in the waters of East Greenland, Iceland and the Faroe Islands have been referred to as West-Nordic Greenland halibut. In 1976 ICES defined the Greenland halibut in these waters as a single stock. Their argument for defining this as a separate stock component was: "... based on a strong probability that the spawning grounds [for Greenland halibut in these waters] are the same". West-Nordic Greenland halibut are widely distributed. In East Greenland waters the main concentrations are found along the continental slope down to about 1600 m. The species is also found on the continental shelf and in the fjords of East Greenland from Cape Farvel (60 degree N) north to Ammassalik (about 66 degree N) (Gundersen and Woll, 1997; Woll and Gundersen 1997). The Greenland halibut is also observed further north in the fjords of the Scoresbysund area.

Gundersen, A.C., Simonsen, C.S., Jørgensen, O., Fossen, I., Lyberth, B., and Boje, J. 2004. Sexual maturity and spawning of Greenland halibut, *R. hippoglossoides*, in West Greenland waters. ICES CM 2004/K:72: 21 p.

Haedrich, R.L. 1995. Structure over time of an exploited deep-water fish assemblage. *In* Deep-water fisheries of the North Atlantic oceanic slope. *Edited by* A.G.Hopper. Kluwer Academic Publishers, Dordrecht, The Netherlands. pp. 27-50.

The structure of a deep water fish assemblage on the upper continental slope of Canada's Labrador Sea was studied using a survey time series dataset from the years 1978 to 1991. Greenland halibut (*Reinhardtius hippoglossoides*) and roundnose grenadier (*Coryphaenoides rupestris*) were the dominant regular members of the assemblage, and both were commercially exploited. Less abundant but regular members of the upper slope assemblage (*Antimora, Centroscyllium, Macrourus,* and *Nezumia*) were not the subject of a fishery, although all occurred as by-catch. Overall biomass of the commercial species declined significantly during the period, and the mean size of Greenland halibut was reduced by half. The biomass of non-target species was less affected, and the mean sizes of less abundant species changed very little, except for broadhead wolffish (*Anarhichas denticulatus*) which almost doubled in size. There were no consistent temperature changes in the geographic area occupied by the assemblage. Population shifts, mostly from north to south and including dominant species such as Greenland halibut and witch flounder (*Glyptocephalus cynoglossus*), took place on the shallower adjacent continental shelf but did not occur within the region. The structure of the assemblage on Labrador's upper continental slope is similar to other upper slope assemblages. Focus on faunal regions and overall species ranges seems preferable to arbitrary management zones. Scientific and socio-economic matters relating to fisheries on the upper slope must be addressed in the same time and space frameworks.

Hafsteinsson, M.P. 1994. Five specimens of albino Greenland halibut, *Reinharditius hippoglossoides* (Walbaum, 1792) caught in Icelandic waters. Natturufraedingurinn 64: 41-46.

[In Icelandic]

According to records, five specimens of albino Greenland halibut have been caught in Icelandic waters. The first four of the fish were caught in bottom trawls by Icelandic stern trawlers 80- 100 nautical miles west of Iceland in 1990, 1992 and 1993. One specimen was caught off the east coast of Iceland in 1993. Unfortunately, only one of the fish was preserved for scientific purposes. However, photographs were taken of the fish caught in 1992 and those are published with this communication, as well as pictures of two Greenland halibuts caught in 1993. These are the first records of albino flatfish in Icelandic waters.

Hammer, C. 1998. Lage und Entwicklung der Fischereiressourcen im Hinblick auf deutsche Fischereiinteressen [State and development of the fishery resources in view of German fishery interests]. Inf. Fischwirtsch. 45: 73-81.
[In German, English summary]

The North-European fish stocks are assessed annually by ICES working groups. The results are evaluated biannually in two meetings of the Advisory Committee for Fisheries Management (ACFM) at ICES. Based on the working group assessments, ACFM formulates an advice for fisheries management and suggests a total allowable catch (TAC) which is based strictly on biological grounds. The summaries of the state of some selected stocks which are given here, are derived from the ACFM advice, formulated during the most recent Oktober 1998 meeting. For many of the fish stocks the precautionary approach is still in the process of implementation, however, for most of them the management and target reference points have been fully defined by now.

Hammer, C. 1999. Berteilung der Fischbestaende in Nordatlantic, Nord- und Ostsee - Einschaetzung durch den Internationalen Rat fuer Meeresforschung vom Mai 1999 [The situation of the fish stocks in the North Atlantic, North and Baltic Sea - assessment of the International Council for the Exploration of the Sea]. Inf. Fischwirtsch. Fischereiforsch 46: 9-16.
[In German, English summary]

The spring session of ACFM gave advice for a number of stocks in the North Atlantic, North Sea and Baltic. The situation is given here for stocks of higher importance for the German fishery. These are: Blue Whiting: A short term upwards trend is observed, which, however, will not last very long, due to too intense fishing. Cod in Kattegat: Stock is outside safe biological limits. No immediate recovery in sight. Cod in Sub. Div. 22-24 (Baltic): Stock is outside safe biological limits. Due to weak recruitment not immediate recovery in prospect. Greenland Halibut: Stock outside safe biological limits and still in downward trend. Herring (Atlanto-scandian, Norw. spring spawner): Stock inside safe biological limits, weak recruitment of the past 5 years will, however, lead to a reduction of the biomass. Redfish: Generally decreasing tendency observed, a reduction of the fishery is recommended. Stocks of herring and sprat in the North and Baltic Sea and waters west of the British Isles are discussed separately by T. Groehsler and C. Zimmermann on pp. 17 to 23.

Hammer, C., Groehsler,T., and Zimmermann,C. 2000. Die Lage der Fischbestaende in Nordostatlantik, Nord- und Ostsee [The fishery resources in the North-East Atlantic, North Sea and Baltic Sea: Estimation by ICES in spring 2000]. Inf. Fischwirtsch. Fischereiforsch 47: 111-126.
[In German, English summary]

The spring session of ACFM gave advice for a number of stocks in the North Atlantic, North Sea and Baltic. The present assessment of the situation is given here for stocks of higher importance for the German fishery. These are: blue whiting, (*Micromesistius* *poutassou*), the stock is still relatively high, this, however, will not last very long, due to too intense fishing; Atlantic cod, (*Gadus morhua)*, in the Kattegat the stock is outside safe biological limits, there is no immediate recovery in sight; cod in 22-24 (Baltic), the stock is inside safe biological limits; F, however, is above the recommendation of the IBSFC; and Greenland Halibut, *(Reinhardtius hipppoglossoides*), the state of the stock is not quite clear. The present fishing intensity seems to be sustainable. Herring (*Clupea harengus*), an Atlanto-scandian, Norwegian spring spawner, stock is within safe biological limits, weak recruitment of the recent years will lead to a reduction of biomass. Herring, for Baltic spring spawner in 22-24 and IIIa there is still no increasing tendency detectable. North Sea Herring, further increasing tendency, with 900 000 t over B sub(lim), good recruitment. Herring in VIa, stable. Redfish (*Sebastes*): generally decreasing tendency observed, a reduction of the fishery is recommended. Signs of recovery, however, are visible for some units.

Hammill, M.O., Lydersen, C., Kovacs, K.M., and Sjare, B. 1997. Estimated fish consumption by hooded seals (*Cystophora cristata*), in the Gulf of St. Lawrence. J. Northwest Atl. Fish. Sci. 22: 249-257.

Fish consumption by hooded seals (*Cystophora cristata)* in the Gulf of St. Lawrence was estimated by bringing together information on individual energy requirements, population size, distribution and diet composition. Aerial surveys indicated that pup production had increased from 2 006 in 1991 to 3 978 in 1994. A Leslie Matrix population model suggested that the population had increased from 10 000-11 000 animals in 1991 to 11 000-16 000 animals in 1995, depending on the mortality rates used in the model. Individual daily requirements were estimated using the daily energy requirements, a daily growth increment, and the basal metabolic rate. Summing individual energy requirements over the period that hooded seals are thought to be in the Gulf of St. Lawrence, gave an increase in total fish consumption from 5 100-5 600 tons in 1991 to 5 600-8 400 tons in 1995. Assuming that the diet of the Gulf of St. Lawrence hooded seals was similar to that of animals collected off the Newfoundland coast, much of this consumption would have probably consisted of Greenland halibut (*Reinhardtius hippoglossoides*) and redfish (*Sebastes* sp.).

Hansen, M.M. 1982. Trend monitoring: III. Statistical analysis of factors affecting the concentrations of cadmium, copper and zinc in three species of fish. ICES CM 1982/E:27: 11 p.

The present paper studies the effects of the parameters year, season, sex, length, and weight on the concentrations of cadmium, copper and zinc in three species of fish caught over a period of six years in a Greenland fjord.

Hareide, N.-R. and Garnes, G. 1998. The distribution and abundance of deep water fish along the Mid-Atlantic Ridge from 43 deg N to 61 deg N. ICES CM 1998/O:39: 16 p.

The data we present were collected from one trawl and three longline exploratory surveys and covering the depths between 400 and 2,000 meters. The majority of the information is from depths between 500 and 1,200 meters. Information on 56 species from 27 families is presented with regard to temperature, geographical distribution and depth. For some species, new information on geographical distribution is presented. In the northern part of the ridge sub-Arctic species such as *Sebastes* spp., tusk and Greenland halibut are dominant. In the southern part, sub tropical species such as golden eye pearch and cardingal fish are the dominant species. In the areas between 40 deg N and 52 deg N there is a change in species composition. Some species seem to have their northernmost distribution, on the ridge, in this area, and others seem to have their southernmost distribution in this area. However some species such as orange roughy, round nose grenadier and leafscale sulper shark are distributed in the whole area.

Hareide, N.-R. and Garnes, G. 2001. The distribution and catch rates of deep water fish along the Mid-Atlantic Ridge from 43 to 61 degree N. Fish. Res. 51: 297-310.

The data presented were collected from one trawl and three longline exploratory surveys to the Mid-Atlantic Ridge and covered the depths between 400 and 2000 m, but mainly between 500 and 1200 m. Information on 56 species from 27 families is presented with regard to temperature, geographical distribution and depth. For some species, new information on geographical distribution is presented. In the northern part of the Ridge (north of 52 degreeN) sub-Arctic species such as *Sebastes* spp., tusk (*Brosme brosme*) and Greenland halibut (*Reinhardtius hippoglossoides*) are dominant. In the southern part (south of 48 degreeN), sub-tropical species such as golden eye perch (*Beryx splendens*) and cardinal fish (*Epigonus telescopus*) are the dominant species. The area between 48 and 52degreeN is a region of faunal change where some species seem to be at either the northern or southern limit of their distribution.

Haug, T. and Gulliksen, J. 1982. Size, age, occurrence, growth, and food of Greenland halibut, *Reinhardtius hippoglossoides* (Walbaum) in coastal waters of western Spitzbergen. Sarsia 67 : 293-297.

The fishes were caught at depths below 300 m and were from 9 to 58 cm long. They belonged to six year classes, but most of them were from one to four years old. Western Spitzbergen waters thus seem to be a nursery ground for this species. The average yearly increment in length was nearly 8 cm. The polar cod, *Boreogadus saida* (Lepechin), was the most important food item for the investigated juvenile Greenland halibut.

Haug, T., Bjoerke, H., and Falk-Petersen, I. B. 1989. The distribution, size composition, and feeding of larval Greenland halibut (*Reinhardtius hippoglossoides* Walbaum) in the eastern Norwegian and Barents seas. *In* The early life history of fish: the third ICES symposium, Bergen, 3-5 October 1988. *Edited by* Blaxter, J. H. S., Gamble, J. C., and Westernhagen, H. V. International Council for the Exploration of the Sea. Rapports et procès-verbaux des réunions; 191. pp. 226-232.

During ichthyoplankton surveys, and 0-group fish annual surveys in the upper 60 m, pelagic Greenland halibut larvae were found along the continental slope, mainly from 71 degree N and northwards to the Spitsbergen banks and coastal waters. In certain years some pelagic Greenland halibut larvae were transported eastwards into the Barents Sea. The possibility that the eastern Norwegian and Barents Seas Greenland halibut stocks spawn over a very long period with continuous transport of small larvae northwards (in some cases also eastwards) by ocean currents, is discussed. The diet of the pelagic larvae was crustaceans, in particular copepods. Some 1-group juveniles caught in Spitsbergen waters also ate crustaceans, the amphipod *Parathemisto libellula* in particular, but quite frequently also *Hyperia galba, Pandalus borealis* and copepods.

Hayashi, K. 1983. On the lesser halibut, *Reinhardtius hippoglossoides* (Walbaum) [Ezokarasugarei, *Reinhardtius hippoglossoides* (Walbaum)]. Can. Transl. Fish. Aquat. Sci. 5026: 9 p.
[Translated from Japanese. Original appeared in: Hokusuishi Geppo (Monthly Bulletin of the Hokkaido Fisheries Experiment Station). 15 (3):3-8, (1958)]

The characteristics of the lesser halibut (*Reinhardtius hippoglossoides)* are presented together with the points of external difference from *Atheresthes evermanni.*

He, P. 2005. Characteristics of bycatch of porcupine crabs, *Neolithodes grimaldii* (Milne-Edwards and Bouvier, 1894) from deepwater turbot gillnets in the northwest Atlantic. Fish.Res. 74: 35-43.

Porcupine crabs, *Neolithodes grimaldii* (Milne-Edwards and Bouvier, 1894), are caught as bycatch in deepwater gillnets targeting turbot (*Reinhardtius hippoglossoides*) off Newfoundland and Labrador and in Davis Strait in the northwest Atlantic. Biological information was obtained through measurement and examination of samples from gillnets vessels. Carapace length (CL) of the samples ranged from 57 mm to 180 mm with a mean CL of 128 mm. The size of male crabs was larger than that of female in the samples measured. The weight of the crab was similar for both males and females of the same carapace length. Bycatch rates of the crab and catch rates of turbot were analyzed from log books returned from the vessels. Bycatch rates of the crab ranged from 0 to 2800 kg/fleet of 50 nets (mean 297 +/- 18.5 kg/fleet, N = 256). Crab bycatch rates (kg/fleet) increased with the duration the nets were soaked in water, but daily rates (kg/(fleet day)) were relatively steady (mean 50.4 +/- 6.4 kg/(fleet day), N = 166). Greater bycatch rates were recorded in areas north of 59[deg]N and in water depths greater than 1200 m. The average bycatch rate in relation to turbot catch increased with water depth with a mean rate of 19.8 kg of crabs for every 100 kg of turbot (N = 176, S.E. 4.8). It is estimated that a total of 767,000 kg of porcupine crab was caught and discarded by gillnet vessels fishing in Canadian waters in Northwest Atlantic Fisheries Organisation (NAFO) Areas 0, 2, and 3 in 1996, during which a total turbot landing from gillnets from the same areas was around 3,872,000 kg.

Healey, B.P. and Dwyer, K.S. 2005. A simple examination of Canadian autumn survey trends in NAFO Divisions 3LNO for Greenland halibut and American plaice: the impact of incomplete coverage of this survey in 2004. NAFO SCR documents 05/34: 28 p.

The Canadian autumn multi-species survey is an integral component in assessing many stocks within the NAFO Convention Area. During the course of the 2004 autumn multi-species survey, operational difficulties lead to incomplete coverage of the survey in NAFO Divisions 3LNO. We explore the importance of the un-sampled strata in 2004 for computing indices of biomass and abundance, based upon survey results from the previous decade. We restrict this examination to those stocks which incorporate the autumn multi-species survey into analytical assessment methods, focusing on Greenland halibut and American plaice stocks. Based upon this exploration, we comment on the validity of using data from the autumn 2004 survey in assessing these stocks.

Healey, B.P. and Dwyer, K.S. 2005. Greenland halibut (*Reinhardtius hippoglossoides*) in Subarea 2 and Divisions 3KLMNO : trends in recruitment based upon research vessel survey data. NAFO SCR documents 05/65: 16 p.

Recruitment analyses of Sub-area 2 and Divisions 3KLMNO Greenland Halibut have modeled survey indices of juveniles measured by several survey series throughout the stock area. In 2004, the final analysis examined the estimated trends as predicted from ages 3-5 indices. This analysis is updated with the latest available survey information. We also examine the inclusion of the age-aggregated Spanish survey results from Div. 3NO. Results indicate that the 1993-1995 year-classes were the strongest produced over the time period considered (1978-2004). The 1996-2000 year-classes are estimated to be of below average strength; the 2001 cohort is estimated to be slightly above average, albeit with wide confidence intervals.

Healey, B.P. and Mahe, J.C. 2005. An assessment of Greenland halibut in Subarea 2 + Divisions 3KLMNO, with projections under the Fisheries Commission rebuilding plan. NAFO SCR documents 05/63: 54 p.

Using Extended Survivors Analysis (XSA), estimates of stock status of Greenland Halibut in Subarea 2 and Divisions 3KLMNO are updated using the most recent catches and survey information. Results indicate that exploitable (ages 5+) biomass is estimated to be the lowest in the time series, and that the current estimate of average fishing mortality is the highest in the time series. Sensitivity analyses were conducted to examine the robustness of the assessment to the XSA shrinkage parameters. Inclusion of the Div. 3NO Spanish survey data to the calibration dataset was evaluated, but this index was not included in the final run due to the residual patterns over time. Estimates of stock status were also produced using ADAPT software, and were found to be generally consistent with the results from the XSA analyses. Projections conducted using the TACs specified by the Fisheries Commission rebuilding plan indicated that prospects for stock rebuilding are currently poor. Projection results indicate that by 2008, the 5+ biomass will not have recovered to the level estimated for 2003, the year in which the rebuilding plan was established.

Healey, B.P., Cadigan, N.G., and Brodie, W.B. 2001. Analysis of pre-recruit data from surveys for Greenland halibut in NAFO Subarea 2 and Divisions 3KLMNO. NAFO SCR documents 01/44: 16 p.

Research survey data are analyzed to predict year-class strength from 1975 to 1998. Log-additive models with fixed effects that have common variance among pre-specified groups (e.g. group+survey-age combinations) and zero covariance between groups are utilized to model the error structure of the data. Likelihood ratio tests reduce the number of variance parameters estimated. The most parsimonious model indicates that the 1993, 1994, and 1995 estimates of year-class strength are predominant over the time period, and that the most recent estimate of year class strength (1998) is below both mean and median year-class strength.

Healey, B.P., Cadigan, N.G., and Brodie, W.B. 2002. Analysis of pre-recruit data from surveys for Greenland halibut in NAFO Subarea 2 and Divisions 3KLMNO. NAFO SCR documents 02/21: 15 p.

Research survey data are analyzed to predict relative year-class strength of Greenland halibut *Reinhardtius hippoglossoides)* from 1975 to 2000. Log-additive models with fixed year-class strength and survey-age effects that have common variance among pre-specified groups (e.g. group = survey-age combinations) and zero covariance between groups are utilized to model the error structure of the data. Variance estimation of each group is iteratively re-weighted. Likelihood ratio tests reduce the number of variance parameters estimated. The most parsimonious model indicates that the 1993, 1994, and 1995 estimates of year-class strength are predominant over the time period, and the two most recent year class strength estimates, the 1999 and 2000 cohorts are also relatively strong.

Healey, B.P., Bowering, W.R., and Dwyer, K.S. 2003. Estimating year-class strength and total mortality for Greenland halibut from surveys in NAFO Subarea 2 and Divisions 3KLMNO. NAFO SCR documents 03/40: 14 p.

Recent assessments of Greenland halibut (*Reinhardtius hippoglossoides)* in NAFO Subarea 2 + Div. 3KLMNO have included multiplicative modeling of swept area abundance estimates from a variety of stratified random survey series. This paper reruns the model using the data files updated with the most recent survey information as well as presents a re-structured model using different survey series based on stratified mean catches per set. Although the estimated strength of the various year-classes varies somewhat, the strong 1993-95 year-classes still dominate in all analyses. In addition, it appears that the 2000 and 2001 year-classes may be above average as well. Estimates of total mortality (Z) from survey data in Div. 2J+3K indicate an increasing trend in Z primarly for ages 4 to 11 peaking around the early-1990s. It declined again until about 1995 after which it has been increasing especially for ages 5-9. The 2002 values are near the highest in the series. Increasing mortality trends also were indicated for the most recent cohorts of the mid-1990s with higher Z values than any others in the series.

Healey, B.P., Bowering, W.R., and Dwyer, K.S. 2004. Greenland halibut (*Reinhardtius hippoglossoides*) in Subarea 2 and Divisions 3KLMNO: trends in recruitment based upon research vessel survey data. NAFO SCR documents 04/46: 14 p.

Recruitment analyses of Sub-area 2 and Divisions 3KLMNO Greenland halibut (*Reinhardtius hippoglossoides*) in recent assessments have modeled survey indices at ages 1-4, as measured by several survey series throughout the stock area. The current analysis is updated with the latest available survey information. Results indicate that the 1993-1995 year-classes were the strongest produced over the time period considered (1978-2003). Recent year-classes also appear to be relatively strong, but estimates are based on information at younger ages only (primarily ages 103). Examination of the data from individual survey series by age indicates that the relative strengths of good year-classes tend to be much higher at the youngest ages compared to ages just prior to entry to the fishery. To evaluate the model effect model estimates are compared of year-class strength using ages 3-5 data and ages 1-4 data. The results are generally similar in that the mid-1990's year-classes are still estimated to be the strongest in the time series. However, in the ages 3-5 analysis the mid 1980s year classes are also above average and the overall year class strengths relative to the mean are much less variable.

Hellou, J., Hopkins, T.E., and Upshall, C. 1995. Contaminants in muscle of plaice and halibut collected from the St. Lawrence Estuary and Northwest Atlantic. Chem. Ecol. 11: 11-24.

Levels of aromatic hydrocarbons in muscle of plaice *Hippoglossoides platessoides* and halibut *Reinhardtius hippoglossoides* were determined by fluorescence, using the chrysene standard, as recommended by the International Oceanographic Commission, for the analysis of PAH in environmental extracts. Concentrations were highest in muscle of halibut collected at the most contaminated, nearshore site, in the Saguenay Fjord of the St. Lawrence Estuary, compared to other locations further from shore. Although concentrations of fluorescing compounds were not statistically different in plaice, the saturated hydrocarbons displayed unquestionably more biodegradation, with a decrease of n-alkanes and increase of branched aliphatics, at the less contaminated site. Synchronous fluorescence indicated the presence of benzenoid and biphenyl hydrocarbons in the extracted mixtures, while GC-MS-TIC analysis tentatively identified the presence of a series of benzenoid (alkyl benzenes), chlorinated (PCB and DDE), N (trialkylamines) and O (phenols) hydrocarbons. These anthropogenic compounds could derive from petroleum products, surfactants and common products used in industry and households. This study emphasizes the importance of a multispectroscopic approach when investigating complex environmental mixtures.

Hellou, J., Warren, W.G., and Mercer, G. 1995. Organochlorines in Pleuronectidae: Comparison between three tissues of three species inhabiting the Northwest Atlantic. Arch. Environ. Contam. Toxicol. 29: 302-308.

Muscle, liver, and gonad from three species of flatfish -- turbot, American plaice, and yellowtail flounder -- collected in the Northwest Atlantic were analyzed for a variety of organochlorine contaminants. Female flounder and plaice had lower concentrations of organochlorines than males, in all tissues. Comparing values to those previously obtained for Atlantic cod showed that concentrations in liver, the organ most often used in biomarker studies, followed the order: cod > turbot > plaice > flounder and correlated with lipid content. Muscle concentrations, which are important from a consumers perspective, followed the order: tubot > plaice > flounder > cod and were also correlated with lipids. The concentration of contaminants in gonads, the organ that informs on the future of a species were nearly undetectable. Cluster analyses demonstrated that the environmental behaviour of these contaminants can be subdivided into groups, consistent with their known chemical origin. Of the series of total and specific polychlorinated dibenzo-p-dioxins and furans studied, only tetrachlorodibenzofuran was present in most tissues.

Herbst, J.F.W. 1966. Description of the flounder of "Hellebutte" louse. Can. Transl. Fish. Aquat. Sci. 686: 10 p.
[Translated from German "Beschreibung der Flinder - oder Hellebuttenlaus"; original appeared in: Schrift. d. Gessellsch. Naturf. Freunde zu Berlin. III: 94-102, 1781]

Heymans, J.J. 2003. Fitting the Newfoundland model to time series data. *In* Ecosystem models of Newfoundland and Southeastern Labrador: additional information and analyses for 'Back to the Future'. *Edited by* J.J.Heymans. University of British Columbia. Fisheries Centre, Vancouver, BC. pp. 72-79.

This paper fits the 1985-1997 model to reconstructed time series data. The time series data includes biomass estimates obtained from Engels and Campelen trawls for demersal species. Catch estimates were obtained from research reports and the SAUP catch database. Changes were made to the biomass accumulation in the Ecopath base model and to the flow control "vulnerability" parameters of groups that were fitted. A forcing function was estimated and compared to the North Atlantic oscillation. All these changes reduced difference in the sum of squares of the estimated biomass to the time series biomass from 632 to 543.

Heymans, J.J. 2003. Revised models for Newfoundland for the time periods 1985-87 and 1995-97. *In* Ecosystem models of Newfoundland and southeastern Labrador: additional information and analyses for 'Back to the Future'. *Edited by* J.J.Heymans. University of British Columbia. Fisheries Centre, Vancouver, BC. pp. 40-61.

This paper updates the models for Newfoundland (NAFO Div. 2J, 3K, 3L, 3N and 3O) for 1985-87 and 1995-97. Data obtained from previous models, DFO-Newfoundland, stock status report, and other literature, were used to update the 1985-87 and 1995-97 models for this area. Comparisons between the Newfoundland, eastern Scotian Shelf, northern Gulf of St. Lawrence and southern Gulf of St. Lawrence models were used to calibrate some of the values used in the Newfoundland models. The models were finally reduced to 30 compartments for comparison between the Newfoundland, eastern Scotian Shelf and Gulf of St. Lawrence.

Hognestad, P. T. 1967. Notes on Greenland halibut, *Reinhardtius hippoglossoides* (Walbaum), in the Eastern Norwegian Sea. Fiskeridir. Skr. Ser. Havunders.; 15. pp. 139-144
[In Norwegian, English summary]

The distribution of *Reinhardtius hippoglossoides* (Walbaum), Greenland halibut, in the Norwegian Sea is described with special reference to the distribution in the eastern part of the area. The only records of O- and I-group Greenland halibut in this area are made in Spitsbergen waters. The distribution of O- and I-group fish together with the hydrographical conditions along the slope of the continental shelf between Norway and Spitsbergen lead to the conclusion that the main spawning area of Greenland halibut must be along the slope between 70 degree N and 75 degree N in April-June at depths between 400 and 800 m.

Holley, J.F. and Marchal, P. 2003. Defining fisheries as operational units to carry out mixed-fisheries forecasts and management. ICES CM 2003/V:24: 24 p.

A typology has been made of the French off-shore fleet fishing in the North-East Atlantic. The investigation was carried out separately for all years between 1983 and 2002. Two statistical techniques were combined: MCA and cluster analysis. In 1985, the majority of vessels targeted saithe in Western Scotland (vessels from Lorient) and in the Northern North Sea (vessels from Boulogne and Fécamp). Probably due to the decline of the saithe biomass, some vessels started to target deep-water species: blue ling (late 1980s), roundnose grenadier (1990) and orange roughy (1991). In the nineties, the deep-water species fishery developed and diversified. In 2002, Boulogne vessels fished exclusively saithe (>80%) or deep-sea species and Lorient ships fished a majority of deep-sea species with 10-20% of saithe and 10-20% of blue ling. Based on these findings, a number of fisheries could be identified over the period 1985-2002. Such fisheries may be used as operational units to carry out e.g., mixed and multi-stock fisheries forecasts and management.

Horsted, S.A. 1980. Denmark (Greenland) research report for 1979 . NAFO SCS documents 80/VI/17 Rev.: 14 p.

Horsted, S.A. and Smidt, E. 1982. Denmark (Greenland) research report for 1981. NAFO SCS documents 82/VI/16: 20 p.

Horsted, S.A. and Smidt, E. 1983. Denmark (Greenland) research report for 1982. NAFO SCS documents 83/VI/14: 13 p.

Hovde, S.C., Albert, O.T., and Nilssen, E.M. 2002. Spatial, seasonal and ontogenetic variation in diet of Northeast Arctic Greenland halibut (*Reinhardtius hippoglossoides).* ICES J. Mar. Sci. 59: 421-437.

This paper describes spatial, temporal and biotic patterns in the diet of Greenland halibut (*Reinhardtius hippoglossoides*, Walbaum) sampled from three different areas of the Barents Sea, namely the Hopen Deep (nursery area), the Bear Island Channel and the continental slope (spawning ground), during April 1996 to January 1998. Percentage of empty stomachs was based on 3294 specimens, and the relative importance of prey groups was assessed using stomach contents from 486 specimens. Multivariate analyses (i.e. Correspondence Analysis and Canonical Correspondence Analysis) were applied to examine which variables could best account for dietary variation. Spatial (horizontal and vertical) and temporal components appeared to be most influential on the variation in diet composition, whereas biotic variables (i.e. predator size, sex and maturity stage) appeared to be of less importance. It is proposed that regional and seasonal differences in diet composition are caused by spatial and temporal variations in abundance and distribution of some of the major prey species, i.e. Atlantic herring (*Clupea harengus*) and capelin (*Mallotus villosus*). On the slope there were also clear ontogenetic changes in diet; in smaller Greenland halibut (<50 cm) crustaceans and the cephalopod Gonatus fabricii were the prevailing prey, whereas for larger specimens teleosts and fish offal were the dominating components of the diet. Smaller Greenland halibut appeared to have been foraging at greater depths (>700 m) than the larger ones.

Humborstad, O.B., Furevik, D.M., Løkkeborg, S., and Hareide, N.-R. 2000. Catches of Greenland halibut (*Reinhardtius hippoglossoides*) in ghost fishing gillnets on the Norwegian continental slope. ICES CM 2000/J:08: 10 p.

Catches in deliberately "lost" gillnets were studied during a ten-day cruise conducted at Storegga 70 nm off the coast of mid-Norway in July 2000. Gillnet fleets were deployed at depths of between 537 and 677 m, and soak time varied from one to seven days. Four fleets set 45 days earlier were also retrieved during the cruise. Most of the catch (94 %) consisted of the target species Greenland halibut (*Reinhardtius hippoglossoides*). All individuals were categorized according to seven condition stages ranging from "alive with no injuries" to "only bones remaining". Results revealed that fish could be fully decomposed/consumed within a 24-hour period, probably due to amphipod and isopod scavenger activity. A decline in total catches was first observed after five days whereas catch composition remained stable during the first seven days. After 45 days a relatively high total catch was obtained but only 25 % were still at stages 1-4 (consumable). The cumulative catch after 45 days was estimated at 2.7 and 3.0 tons on the basis of two different methods. Gillnets retrieved after 45 days were evaluated as being highly effective, with gear saturation being the only factor leading to decreased efficiency.

Humborstad, O.B., Løkkeborg, S., Hareide, N.-R., and Furevik, D.M. 2003. Catches of Greenland halibut (*Reinhardtius hippoglossoides*) in deepwater ghost-fishing gillnets on the Norwegian continental slope. Fish. Res. 64: 163-170.

Fishing gear may continue to fish after it has been lost. Large catches have been observed during cruises to retrieve lost gillnets in Norwegian waters, especially in the fishery for Greenland halibut (*Reinhardtius hippoglossoides*). The Norwegian Greenland halibut is overexploited, and there is serious concern about the effect of lost nets on this stock. Catches in deliberately lost gillnets were studied in the fishery for Greenland halibut off the coast of mid-Norway in July 2000 and June 2001. Gillnet fleets were deployed at depths of between 537 and 851 m, and the soak time ranged from 1 to 68 days. Most of the catch consisted of the target species, and the proportions of different species did not change with soak time. All individuals caught were categorized in terms of seven condition states. A gradual shift from fresh to decomposed individuals over time was evident. The catching efficiency of gillnets decreased with soak time, presumably due to the weight of the catch causing the headline height to decrease, and after 45 days was only about 20-30% of that of nets used in the commercial fishery. Catch rates were estimated after stabilization at 67-100 and 28-43 kg per day per gillnet fleet in 2000 and 2001, respectively. The results indicated that gillnets lost in this area continue to fish for long periods of time. Annual losses of nets need to be quantified in order to estimate the effects of ghost fishing on stock levels, a figure that is currently lacking.

Huse, I. 2000. Size-selection of cod, haddock and Greenland halibut in trawl, longline and gillnets with possible impacts on life history parameters. Thesis (Ph.D.) University of Bergen, Bergen, Norway.

The increase in commercial fisheries during the past 50 years has made the problem of bycatches and discards one of the most important issues in fisheries science. Alverson et al. (1994) estimated that all marine fisheries combined together produce 28.7 million tonnes of bycatch, of which 27 million tonnes are discarded. This is equivalent to almost one third of landings. The fractions of discards and bycatches due to minimum landing size regulations, unmarketable species or price differences between size groups of the same species were not estimated separately by Alverson et al. (1.994), but these three factors are the most important reasons for the discard problem. Alverson has refuted the criticism that his estimates were too large and pointed out that during the past decade there has been a decline in discard levels due to a decline in fisheries with high discard rates, time/area closures, new and selective harvesting strategies, greater utilization for human consumption, the prohibition of discarding in certain countries and a more progressive attitude by fisheries managers, user groups, and society towards the need to resolve the bycatch problem (Alverson, 1999). An ideally selective fishing gear would produce only catches of the desired size of the target species, with full survival of all other specimens, resulting in no discards or bycatches. As long as the selectivity of the gear was adequate, for the species harvested, the risk of growth or recruitment overfishing would be reduced. Growth overfishing occurs when harvesting removes so many small fish that the maximum growth potential of the stock cannot be achieved. Recruitment overfishing occurs when the harvest impairs the reproductive potential of the population, either by eliminating spawning stock components or seriously reducing the spawning stock biomass (e.g. Aiken and Sinclair, 1995). The objectives of this thesis are: 1. To investigate differences in the size selectivity of trawl, longline and gillnet for cod, haddock and Greenland halibut within a specific time window and geographical area. 2. To determine effects of hook modifications and changes in fishing strategy on selectivity in pelagic longline fishing. 3. To investigate effects on selectivity in trawl, longline and gillnet fisheries by changing fishing strategies. 4. To investigate the possible effects of selective harvesting in the course of several years on the life history parameters of Greenland halibut.

Huse, I. and Johansen, T. 2001. Trends in growth parameters analysed in the light of selection responses to the exploitation of Greenland halibut. NAFO SCR documents 01/159: 11 p.

The possibility that fishing pressure has an effect on the evolution of life histories and yields of fish is of great importance for management purposes. Nevertheless, this possibility has been widely ignored because of the difficulty of finding direct evidence for it. It has been proposed that observed reductions in the growth rate and yield of the North sea cod (*Gadus morhua)* is an effect of life history changes, initiated by removing the largest individuals within the selection range of the trawls in a heavy fishery for cod. This study analyses growth as a measure of selection responses in Greenland halibut (*Reinhardtius hippoglossoides*). The Greenland halibut has been heavily exploited in the North East Atlantic since the 1970s. The fishery for this species was strictly regulated in 1992. Trawls, longline and gillnets were used in the fishery that has led to a collapse of the stock. The selective properties of these gears could lead to a repeated selection of the largest individuals in a year class before reproduction. Growth is analysed in a nine-year perspective and the results discussed in the light of evolution and gear selection parameters. No conclusive evidence of significant selection differentials was found.

Huse, I. and Nedreaas, K. 1995. Preliminary length selection curves of trawl fishing for Greenland halibut (*Reinhardtius hippoglossoides*). NAFO SCR documents 95/22: 7 p.

A selection curve for Greenland halibut (Reinhardtius hippoglossides) is drawn, based on alternating trawl hauls with 100- and 135-mm meshes in extension and cod-end, used in the Norwegian experimental fishery in June 1993. The SELECT model made by R.B. Millar is used to fit the selection curve and calculate the essential parameters. The results indicate a l sub(50) at 36 cm. The selectivity curve made is based on very few points in the lower end of the size-range, probably because of overlapping selectivity curves for the meshsizes used. A selection experiment will be done in August 1995 to complete the curve. To establish the upper part of the curve a comparison to longline-catches and gillnetcatches from different mesh sizes will be done.

Huse, I., Nedreaas, K., and Gundersen, A. 1997. Relative selectivity in trawls, longline and gillnets on Greenland halibut. *In* Gear selection and sampling gears: proceedings of the seventh IMR-PINRO symposium. *Edited by* Shleinik, V. and Zaferman, M. PINRO, Murmansk, Russia. pp. 107-120.

Selectivity parameters for Greenland halibut (*Reinhardtius hippoglossoides*, Walbaum) are compared to catches reported from trawl, gillnets and longline in the Norwegian scientific fisheries for Greenland halibut. A trouser trawl selectivity experiment reported here gives an L50 at 43 cm in 135 mm cod-end. A selectivity analysis of the gillnets using loglinear models is done, and shows maximum retention probability for lengths at 40.6-63.8 cm for the five mesh-sizes used. The effect of the fishing strategy is analyzed in respect to the selectivity of the gear used and the distribution of length and age in the catches. To avoid possible bias from strong dominating year-classes and selection in these comparisons, length-at-age data are used. The sex-ratio in gillnet catches is shown to be a linear function of mesh-size. Our data show no trend in length distribution with depth. We show that calculated growth of female Greenland halibut is affected by the selectivity of the gears. It is shown that growth parameters calculated from gillnet catches may be biased due to the selection properties in the gillnets. These analyses will provide a better understanding of possible sampling bias when sampling a stock with only one gear.

Huse, I., Gundersen, A.C., and Nedreaas, K.H. 1999. Relative selectivity of Greenland halibut (*Reinhardtius hippoglossoides*, Walbaum) by trawls, longlines and gillnets. Fish. Res. 44: 75-93.

Selectivity parameters for Greenland halibut (*Reinhardtius hippoglossoides*, Walbaum) were calculated from trawl and gillnet catches in the Norwegian scientific fisheries for Greenland halibut. Within the chosen individual areas and seasons, our data show no trend in length distribution with depth. A trouser-trawl selectivity experiment gave an L sub(50) at 42 cm in a 135 mm cod-ends. A selectivity analysis of the gillnets using a log normal model showed maximum probability of retention for lengths of 46.8-73.5 cm for 140-220 mm stretched meshes. By using expected catch proportions and life history parameters, the selectivity in longline and trawl was shown to be bell-shaped, both gears losing both the smallest and largest fish. Calculated estimated life-history parameters were biased by sampling gears, giving slower growth and larger L proportional to for females caught in gillnets. The maturation length (M sub(50)) of female Greenland halibut was largest in trawl catches, smallest for gillnet catches. The sex ratio in the gillnet catches was shown to be a direct function of mesh size. These analyses will provide a better understanding of possible sampling bias when sampling a stock by means of only one type of gear.

Hvingel, C. 1995. Denmark/Greenland research report for 1994. NAFO SCS documents 95/14: 6 p.

Hvingel, C. 1996. Denmark/Greenland research report for 1995. NAFO SCS documents 96/9: 7 p.

Hylen, A. and Nedreaas, K. H. 1995. Pre-recruit studies of the North-east Arctic Greenland halibut stock. *In* Precision and relevance of pre-recruit studies for fishery management related to fish stocks in the Barents Sea and adjacent waters. IMR-PINRO symposium (6th), Bergen, Norway, 1994. *Edited by* Hylen, A. Institute of Marine Research (Norway), Bergen, Norway. pp. 229-238.

Abundance indices of 0-group Greenland halibut (*Reinhardtius hippoglossoides*) from the international 0-group surveys in the Barents Sea showed a sudden decrease from 1987 to 1988 to a low level which has remained for the last 5-6 years. The strength of these weak year-classes has been confirmed in later youngfish surveys, and this has caused strong regulations of the fishery at a time when the fishery itself was good. The drop in recruitment is discussed and related to a reduction of the spawning stock.

Hylen, A., Jacobsen,J.A., Mehl, S., and Nedreaas, K. 1988. Estimates of stock size of cod, haddock, redfish and Greenland halibut in the Barents Sea and the Svalbard area autumn 1987. ICES CM 1988/G:44: 25 p.

Hylen, A., Loeng, H., Mehl, S., and Nedreaas, K. 1989. Estimates of stock size of cod, haddock, redfish and Greenland halibut in the Barents Sea and the Svalbard area autumn 1988. ICES CM 1989/G:39: 26 p.

Combined acoustic and bottom trawl survey for cod (*Gadus morhua*), haddock (*Melanogrammus aeglefinus*) and redfish were carried out in autumn 1988 in the Svalbard area together with an acoustic survey in the Barents Sea. The abundance indices of cod decreased from 1987 to 1988 both in the Svalbard area and in the Barents Sea where the index has decreased since previous autumn and since last winter. The results for haddock show that the stock is almost not present in the Svalbard area and that it has decreased in the Barents Sea. The present stock situation of the redfish species *Sebastes marinus* in this northern part of the species' geographical distribution show a decreasing trend since 1985-1986 although the acoustic survey gives a higher index in

1988 compared to 1987. The abundance indices of *S. mentella* point to a more stable stock situation for this species after an alarming period of yearly decrease. Both the bottom trawl survey and the acoustic survey in 1988 confirm this. The abundance of Greenland halibut (*Reinhardtius hippoglossoides*) has increased to the 1985 level.

Høines, Å.S. and Korsbrekke, K. 2001. Some aspects of a time series of longline catch-per-unit of effort data for Greenland halibut (*Reinhardtius hippoglossoides*). NAFO SCR documents 01/119: 10 p.

Data from a yearly longline survey from 1992-2000 (Greenland halibut, *Reinhardtius hippoglossoides*) are analysed. The survey attempts to mimic the commercial fishery. The catch per unit of effort has seen a large increase over the time period. This seems to be partly an artefact of a trend in the reported number of hooks used per setting and the change from targeting both cod and Greenland halibut to only targetting Greenland halibut at a greater depth. Controlling for these effects is difficult, but indicate a more modest increase in CPUE, which is comparable with CPUE data from a similar gill-netter survey. The changing depth coverage of the survey in combination with the change in number of hooks makes it difficult to interpret the trend.

Høines, Å.S. and Korsbrekke, K. 2001. Variation in population structure of northeast Arctic Greenland halibut (*Reinhardtius hippoglossoides*) based on data from Norwegian surveys in the period 1992-2000. NAFO SCR documents 101/118: 13 p.

The variation in population structure of Northeast Arctic Greenland halibut (*Reinhardtius hippoglossoides* Walbaum) is analysed using data from three different surveys, trawl, longline and gillnet, in the slope area of the western Barents Sea in the period 1992-2000. The design of the longline and gillnet survey had limitations in that they were set to simulate the commercial fisheries, but the vessels were forced to cover the most important part of the slope area. Greenland halibut was the dominant species both in numbers and weight and was usually caught in the range of 5-15 years old, but the catch was dominated by ages 6-12 and fish older than age 8 consisted primarily of females. The data showed differences in sex composition and age composition both by area and by depth, and catches from trawl showed the most evident pattern.

Høines, Å.S. and Korsbrekke, K. 2003. Population structure of Greenland halibut (Reinhardtius hippoglossoides) in the Northeast Arctic, 1992-2000. J. Northwest Atl. Fish. Sci. 31: 85-97.

The variation in population structure of Greenland halibut (*Reinhardtius hippoglossoides* Walbaum) in the Northeast Arctic is analysed using data from three different surveys using trawl, longline and gillnet gears, in the slope area of the western Barents Sea in the period 1992-2000. The design of the longline and gillnet survey had limitations in that they were set to simulate the commercial fisheries, but the vessels were forced to cover the most important part of the slope area. Greenland halibut was the dominant species both in numbers and weight and was usually caught in the range of 5-15 years old, but the catch was dominated by ages 6-12. The data showed differences in sex composition and age composition both by area and by depth, and catches from trawl showed the most evident pattern. Greenland halibut caught by gillnet were larger and older than fish caught by trawl and the results from longline were in between. In most of the age groups, males were significantly smaller than females and this general trend was shown for all gears. Males also dominated the younger age groups in all gears and Greenland halibut older than 10 years were virtually all females. Fish from the earliest cohorts in the years investigated were generally smaller than fish from later ones.

Høines, Å. and Smirnov, O. 2004. Investigations of demersal fish in the Svalbard Area in the Autumn 2003, with special attention on juvenile Greenland halibut. IMR/PINRO Joint

Report series 4: 32 p.

Institute of Marine Research in Bergen started in 1996 a program to investigate to what degree Greenland halibut's nursery grounds extended to the north and east of Spitsbergen, and Norwegian vessels executed this survey until 1999 with coverage with some stations into the Russian EEZ in 1998 and 1999. The annual meeting between Russian and Norwegian scientists decided to extend this survey to a joint survey, and the first year with joint effort with a Russian and a Norwegian vessel was year 2000. The survey was conducted as a traditional bottom trawl survey with main focus on Greenland halibut, but also analyses were carried out for cod, redfish and long rough dab. The main results in 2003 were: Ice conditions in 2003 were the worst in the survey history and this caused significant limitation of surveyed area. Water temperature on the investigated area at surface was less than, in 2002, and near bottom slightly lower in the eastern part and higher in the northern area. Due to heavy ice conditions it had been impossible to conduct observations in the important areas where dense concentrations of young Greenland halibut had been found in previous years. It leads to a decline in the abundance indices of all Greenland halibut length groups in comparison with estimates obtained in 2002. Abundance index for cod in 2003 was four times less than in 2002 and interpreted as the second smallest in the time series, only the result from 1993 was lower. The reduction was observed in all length groups with the exception of the young fish within 10-14 cm. The abundance of redfishes (both *S. marinus* and *S. mentella)* was about two times higher than in 2002 in spite of the reduced distribution area. Long rough dab abundance indices in 2003 were higher than what was found in 2002, but still remained at the low level in comparison with 1999-2001.

Ianelli, J. N. and Wilderbuer, T. K. 1995. Greenland turbot (*Reinhardtius hippoglossoides*) stock assessment and management in the eastern Bering Sea. *In* Proceedings of the International Symposium on North Pacific Flatfish, October 26-28, 1994, Anchorage Alaska. University of Alaska Fairbanks, Fairbanks, Alaska. pp. 407-441.

The fishery for Greenland turbot, *Reinhardtius hippoglossoides*, in the eastern Bering Sea has increased in the past few years, prompting renewed interest in the condition of the stock. Data on this species has been collected by the National Marine Fisheries Service (NMFS) domestic fishery observer program and by surveys using trawl and longline gear. However, because Greenland turbot have not been the focus of a directed research program, the value of any single data source is limited. In this assessment, we use all available information in a size-based model and evaluate the consequences of different plausible interpretations of survey biomass estimates. These alternatives are then used to project future conditions. Because the fishery is executed by longline and trawl gear which target different age groups, the projections are evaluated under different gear-specific harvest levels. A stochastic recruitment model was used in the projection analysis. Fishing mortality specific to gear and sex was monitored.

Igashov, T.M. 1999. Biological characteristics and bathymetric distribution of Greenland halibut (*Reinhardtius hippoglossoides*) of the Flemish Pass (3LM) area during the fishery of Russia in 1998. NAFO SCR documents 99/11: 15 p.

Material for investigations was collected by researchers-observers on board of two fishing vessels of Russia in May-December 1998. The densest concentrations were being formed by halibut from May to July at depth of 600-800 m, as well as in December at depth of 600-800 m and deeper than 1,200 m. The trawling efficiency during that period exceeded 400kg/hr. From August to November, the density of concentrations decreased, and the efficiency did not exceed 300 kg/hr. The basis of catches was immature specimens and those maturing for the first time. This conforms to the existing conceptions on the Flemish Pass area as one of the nursery areas of Greenland halibut habitat in the North-West Atlantic. In the period of observations a gradual increase of feeding intensity took place, but it decreased in December. Fish, cephalopods and shrimp were the most important objects in feeding. Biology of Greenland halibut of Flemish Pass and that of halibut from other areas of the North Atlantic have similar features. By analogy with the year cycle of halibut from the area of Greenland-Canadian Threshold, that of halibut from the area of Flemish Pass is supposed to have periods of feeding and wintering as well. Summer/autumn feeding took place from May to November. From May to July, halibut concentrated at depths 600-800m. the increase of feeding intensity was caused by the increase of consumption of shrimp and squid and was accompanied by the disperse of Greenland halibut concentrations. Wintering has started in December. During this time, the concentrations became more dense, and catches increased because of concentration of young fish at the depth of 600-800 m and deeper than 1,200 m.

Igashov, T.M. 2001. Comparative analysis of length-age composition of Greenland halibut (*Reinhardtius hippoglossoides*) from the commercial catches taken by Russia, Spain and Portugal in the Flemish Pass (Divisions 3LM) in 1998-2000. NAFO SCR documents 01/13: 5 p.

The data earlier published in the national reports of Spain and Portugal for 1998-1999, as well as the materials from Russian investigations for 1998-2000, are used in this paper. By results from the investigations, the catches taken by three countries consisted of halibut of 22-100 cm long; of 42.7-48.4 cm mean length, with the length groups from 38-39 to 44-45 cm long being predominant. By-catch of young fish below 30 cm did not exceed 1.6% that was not a violation of the mesh-size regulation established. Fish sexual ratio varied slightly; the abundance of females dominated over that of males. The fish age, read by scales and otoliths, made up from 2 to 20 yr, with the specimens at age 4-8 yr being predominant. The age of specimens from dominated age groups in Russian catches was by 1-2 years younger than that from the catches taken by the EU countries. In 1999, occurrence of large-size halibut in the Spanish catches is explained by a large fishing depth used during that year. In 2000, appearance of small-size halibut in the Russian catches is explained by a significant increase in proportion of recruits in 1994-1995. Age difference in halibut specimens by 1-2 years for the Russian samples and for the samples taken by the EU countries is probably accounted for in a different method of age reading used by age readers. Absence of a generally accepted method for age determination adversely effects a creation of models by which the decisions are made for the stock management. The conclusion was drawn about a necessity of pooling efforts by the researchers from different countries to search for the optimum methods for age reading and to apply the agreed methods in future.

Igashov, T.M. 2002. Assessment of Greenland halibut (*Reinhardtius hippoglossoides*) stock on the Flemish Cap (Division 3M) by data of the Russian trawl survey of 2001. NAFO SCR documents 02/27: 9 p.

Assessment of abundance and biomass of Greenland halibut (*Reinhardtius hippoglossoides*), as well as fish distribution by depth range are presented using results of the trawl survey carried out in May/June, 2001. Investigations were performed over the area of 16 thou. mile super(2) to the depth of 1 280 m and in accordance with the stratification accepted in the NAFO. Indices of Greenland halibut stock on the Flemish Cap bank in 2001 were constituted as follows: by abundance - 14.2 mill. spec. and biomass - 12.7 thousand tons. According to the Russian survey data of 1995, 1996 and 2001, dynamics of abundance and biomass of Greenland halibut indicate an increase in the stock indices in Div. 3M in 2001. Data on fish length-age composition and distribution are presented. Individuals 13-90 cm long occured in catches at the age of 1-17. The basis of catches (46.7%) consisted of small immature individuals 43-48 cm long. Fish of 1994, 1995 and 1996 year-classes predominated in abundance, their portion in catches constituted 78.8%. The obtained results were compared with results of trawl surveys of

Russia, Canada and the European Union performed in 1987-2001. The expert values of biomass underestimated earlier were derived by results of this analyses.

Igashov, T.M. 2004. Results of comparative age reading of Greenland halibut *Reinhardtius hippoglossoides* (Walbaum) by scales and otoliths. NAFO SCR documents 04/7: 3 p.

Results of comparative reading of Greenland halibut age by otoliths and scale from three parts of the body are presented. Reliability of differences was assessed with the use of Fishers Z-criterion. Discrepancies in age reading between various structures varied from 1 to 3 years, but in most cases age difference did not exceed 1 year. A number of variant readings was quite large in all discussed cases and varied from 28.8 to 33.3% and constituted on average 31.2%. Investigations proved the statistical reliability of differences by materials, in which scales were used taken from under the pectoral fin. It turned out, that results of age reading by scales from this part are sufficiently underestimated. Comparison between spinal and tail parts and otoliths showed that these differences are big, but statistically unreliable.

Igashov, T.M., Golovanov, S.E., and Lobodenko, S.E. 2005. The relationship between water temperature and distribution of Greenland halibut on the Flemish Cap in 1988-2002. NAFO SCR documents 05/31: 9 p.

The present paper investigates a question of the relationship between dynamics of Greenland halibut catches and fluctuations in water temperature at different depths in the Flemish Cap area. Data obtained in the result of international research programs are used in the analysis. Mean catches of Greenland halibut taken using the sampling trawl (individuals/trawl and kg/trawl) during summer trawl surveys by European Union are compared with data on the near-bottom water temperature. Their variability is estimated, correlation analysis of water temperature and catches by four depth intervals is made and significance of the relationships revealed is determined. Results from the investigations bear out the existence of statistically significant relationship between fluctuations in the near-bottom water temperature and variations in the Greenland halibut catches in the Flemish Cap area. This relationship is the most pronounced in the depth range of 100 to 200 fathoms (f). Water temperatures have an effect on the Greenland halibut distribution on the Flemish Cap and thereby on the results of instrumental surveys.

Igland, O.T. and Naevdal, G. 2001. Allozyme studies of Greenland halibut, *Reinhardtius hippoglossoides* Walbaum 1792, from the North Atlantic. Sarsia 86: 237-240.

The possible existence of discrete stocks of Greenland halibut, *Reinhardtius hippoglossoides*, is an important question for conservation and for rational exploitation. A total of 12 enzyme systems investigated by starch gel electrophoresis were interpreted as representing 20 putative loci. Three loci were polymorphic at the 0.95 criterion: GPI-1*, IDHP-2* and PGM*. Tests for heterogeneity in the allele distribution among six sample areas (east and west Greenland, Jan Mayen, the Barents Sea, Faeroe Islands and the Shetland Islands) in the North Atlantic (totally 745 specimens) did not reveal any significant inter-area differences. The results are discussed in the context of life history characteristics and the potential for gene flow, and compared to previous studies using allozyme and mtDNA analyses.

Iglesias, S. and Paz, J. 1995. Spanish North Atlantic deep-water fisheries. *In* Deep-water fisheries of the North Atlantic oceanic slope. *Edited by* A.G.Hopper. Kluwer Academic Publishers, Dordrecht, The Netherlands. pp. 287-295.

The Spanish fishing fleet catches deep-water species on both sides of the North Atlantic Ocean. In terms of catches, the most important commercial species is the Greenland halibut (*Reinhardtius hippoglossoides*) which is caught in the NAFO Divisions 3L, 3M and

3N. In this fishery most research has focused on the Greenland halibut and the paper contains some preliminary information on length distribution, spawning and feeding. The fishery first commenced in 1990 and the fishing effort increased from 9 vessels in 1990 to 33 vessels in 1993. Each vessel makes a voyage of 5 to 6 months. It is the practice to monitor catches, catch information and biological data by employing trained observers on the vessels. Spanish vessels also fish for deep-water species in the eastern North Atlantic, and the paper describes the fishery for various species of deep-water sharks in depths from 400 m. to in excess of 1000 m. using longlines. These fisheries take place in ICES areas VII, VIIIc and IXa. Also in the eastern Atlantic there are Spanish fisheries for monkfish (*Lophius piscatorius* and *L. budegassa*) using gillnets, and a small fishery for *Chaecon affinis*, (formerly *Geryon affinis*) on the Banco de Galicia using longlines and traps. Spanish scientists and fishermen have also carried out surveys in deep-water since 1974 using trawl gear down to 2000 m. and more recently with longlines down to 3400 m.

Ikeda, I. 1971. Japanese research report for 1970. ICNAF Res. Doc. 71/45: 8 p..

Industrial Market Research Limited 1991. Additional material on smoked fish other than salmon in Italy, Germany and France. Institute of Marine Research. 24 p.

Institut Maurice-Lamontagne, Canada. Ministère des pêches et des océans. Région du Québec. Direction des sciences, and Canada. Ministère des pêches et des océans. Région du golfe. Direction des sciences. 1995. Compilation des rapports sur l'état des stocks de poissons de fond du Golfe Saint-Laurent. MPO Pêches de l'Atlantique rapport sur l'état des stocks 95/5F: 121 p.
[In French]

International Council for the Exploration of the Sea. 1998. Extract of the report of the Advisory Committee on Fishery Management : stocks in the North-East Arctic (sub-areas I and II): overview cod, haddock, saithe, redfish, Greenland halibut, Barents Sea capelin, Norwegian spring-spawning herring to the North-East Atlantic Fisheries Commission, the Government of Norway and the Government of Russia. International Council for the Exploration of the Sea, Copenhagen, Denmark. 58 p.

International Council for the Exploration of the Sea. Arctic Fisheries Working Group. 1989. Report of the Arctic Fisheries Working Group, Copenhagen, 20-29 September 1988. ICES CM 1989/Assess:4: 171 p.

International Council for the Exploration of the Sea. Arctic Fisheries Working Group. 1990. Report of the Arctic Fisheries Working Group, Copenhagen, 19-28 September 1989. ICES CM 1990/Assess:4: 151 p.

International Council for the Exploration of the Sea. Arctic Fisheries Working Group. 1991. Report of the Arctic Fisheries Working Group, Copenhagen, 18-27 September, 1990. ICES CM 1991/Assess:3: 127 p.

International Council for the Exploration of the Sea. Arctic Fisheries Working Group. 1992. Report of the Arctic Fisheries Working Group, Copenhagen, 10-19 September 1991. ICES CM 1992/Assess:2: 119 p.

International Council for the Exploration of the Sea. Arctic Fisheries Working Group. 1993. Report of the Arctic Fisheries Working Group, Copenhagen, 25 August - 3 September 1992. ICES CM 1993/Assess:1: 169 p.

International Council for the Exploration of the Sea. Arctic Fisheries Working Group. 1994. Report of the Arctic Fisheries Working Group, Copenhagen, 24 August - 2 September 1993. ICES CM 1994/Assess:2: 240 p.

International Council for the Exploration of the Sea. Arctic Fisheries Working Group. 1997. Report of the Arctic Fisheries Working Group, ICES Headquarters, 21-29 August 1996. ICES CM 1997/Assess:4: 2 pts.

This paper summarizes the results of the longline survey with focus on the catch composition and biology of Greenland halibut. A comparison of the unexploited localities and an exploited locality, may lead to important information about the impact of exploitation on the Greenland halibut stock and on a commercial fishing ground in ICES Division XIVb.

International Council for the Exploration of the Sea. Arctic Fisheries Working Group and ICES Advisory Committee on Fisheries Management. 1998. Report of the Arctic Fisheries Working Group, ICES Headquarters, 20-28 August 1997. ICES CM 1998/Assess:2: 2 pts.

International Council for the Exploration of the Sea. Arctic Fisheries Working Group and ICES Advisory Committee on Fisheries Management. 2000. Report of the Arctic Fisheries Working Group, North-East Arctic Cod and Haddock Sub-group, Bergen, Norway 9-12 May 2000. ICES CM 2000/ACFM:18: 86 p.

International Council for the Exploration of the Sea. Arctic Fisheries Working Group and ICES Advisory Committee on Fisheries Management. 2000. Report of the Arctic Fisheries Working Group, ICES Headquarters, 19-27 August 1998. ICES CM 1999/ACFM:3:276 p.

International Council for the Exploration of the Sea. Arctic Fisheries Working Group and ICES Advisory Committee on Fisheries Management. 2001. Report of the Arctic Fisheries Working Group, Bergen, Norway, 24 April - 3 May 2001 ICES CM 2001/ACFM:19: 390 p.

International Council for the Exploration of the Sea. Arctic Fisheries Working Group and ICES Advisory Committee on Fisheries Management. 2001. Report of the Arctic Fisheries Working Group, ICES Headquarters, 22-31 August 2001. ICES CM 2001/ACFM:02:347 p.

International Council for the Exploration of the Sea. Arctic Fisheries Working Group and ICES Advisory Committee on Fisheries Management. 2002. Report of the Arctic Fisheries Working Group, ICES Headquarters, 16-25 April 2002. ICES CM 2002/ACFM:18: 529 p.

International Council for the Exploration of the Sea. Arctic Fisheries Working Group and ICES Advisory Committee on Fisheries Management. 2003. Report of the Arctic Fisheries Working Group, San Sebastian, Spain, 23 April-2 May 2003. ICES CM 2003/ACFM:22: 460 p.

International Council for the Exploration of the Sea. Arctic Fisheries Working Group and ICES Advisory Committee on Fisheries Management. 2004. Report of the Arctic Fisheries Working Group, 4-13 May 2004, ICES, Copenhagen. ICES CM 2004/ACFM:28: 491 p.

International Council for the Exploration of the Sea. Arctic Fisheries Working Group. 2006. Report of the Arctic Fisheries Working Group, ICES Headquarters, 23 August - 1 September 1994. ICES CM 1995/Assess:3 : 252 p.

International Council for the Exploration of the Sea. Demersal Fish Committee. 1978. Report of the Working Group on Greenland halibut in Region 1, Charlottenlund, 27 February - 3 March 1978. ICES CM 1978/G:4: 29 p.

International Council for the Exploration of the Sea. Demersal Fish Committee. 1979. Report of the Working Group on Greenland halibut in Region 1, Charlottenlund, 7-10 May 1979. ICES CM 1979/G:8: 33 p.

International Council for the Exploration of the Sea. Demersal Fish Committee. 1980. Preliminary report of the international 0-group fish survey in the Barents Sea and adjacent waters in August - September 1980. ICES CM 1980/G:53: 25 p.

Observations concerning the geographical distribution of 0-group fish and their abundance are given in this report together with a brief description of the temperature condition in the area.

International Council for the Exploration of the Sea. Demersal Fish Committee. 1980. Report of the Working Group on redfish and Greenland halibut in Region 1, Copenhagen, 18-25 March 1980. ICES CM 1980/G:4: 107 p.

International Council for the Exploration of the Sea. Demersal Fish Committee. 1981. Preliminary report of the International 0-group fish survey in the Barents Sea and adjacent waters in August-September 1981. ICES CM 1981/G:78: 27 p.

International Council for the Exploration of the Sea. Demersal Fish Committee. 1981. Report of the Working Group on redfish and Greenland halibut in Region 1, Copenhagen, 11-19 March 1981. ICES CM 1981/G:7: 110 p.

International Council for the Exploration of the Sea. Demersal Fish Committee. 1982. Preliminary report of the international 0-group fish survey in the Barents Sea and adjacent waters in August-September 1982. ICES CM 1982/G:44: 27 p.

International Council for the Exploration of the Sea. Demersal Fish Committee. 1983. Preliminary report of the international 0-group fish survey in the Barents Sea and adjacent waters in August-September 1983. ICES CM 1983/G:35.

International Council for the Exploration of the Sea. Demersal Fish Committee. 1985. Preliminary report of the Norwegian groundfish survey at Bear Island and West-Spitsbergen in the autumn 1984. ICES CM 1985/G:65: 17 p.

This report describes the results from a stratified bottom trawl survey carried out in September/October 1984. The cod stock component was dominated by the 1982 and the 1983-year classes. The former most abundant 1979-year class was reduced with 44% compared to the 1983 results. Older haddock were scarce, but good recruitment of the 1983-year class was recorded. The most abundant species in the area were long rough dab and redfish.

International Council for the Exploration of the Sea. Demersal Fish Committee. 1985. Preliminary report of the International 0-group Fish Survey in the Barents Sea and adjacent waters in August-September 1985. ICES CM 1985/G:75: 27 p.

International Council for the Exploration of the Sea. Demersal Fish Committee. 1986. Preliminary report of the International 0-group fish survey in the Barents Sea and adjacent waters in August-September 1986. ICES CM 1986/G:78: 27 p.

International Council for the Exploration of the Sea. Demersal Fish Committee. 1986. Preliminary report of the Norwegian groundfish survey at Bear Island and West-Spitzbergen in the autumn 1985. ICES CM 1986/G:81: 30 p.

This report describes the results from a stratified bottom trawl survey carried out in September/October 1985. The cod stock was dominated by the 1982 and the 1983 year classes. Also the 1984 year class recruited considerably to the area. The year classes 1982-1984 made up 84% of the total index in numbers and the index increased by 130% from 1984 to 1985.

International Council for the Exploration of the Sea. Demersal Fish Committee. 1987. Preliminary report of the International 0-group fish survey in the Barents Sea and adjacent waters in August-September 1987. ICES CM 1987/G:38: 31 p.

International Council for the Exploration of the Sea. Demersal Fish Committee. 1988. Preliminary report of the International 0-group fish survey in the Barents Sea and adjacent waters in August-September 1988. ICES CM 1988/G:45: 37 p.

International Council for the Exploration of the Sea. Demersal Fish Committee. 1990. Preliminary report of the International 0-group Fish Survey in the Barents Sea and adjacent waters in August-September 1990. ICES CM 1990/G:46: 36 p.

The twenty-sixth annual International O-group fish survey was made during the period 16 August - 5 September 1990 in the Barents Sea and adjacent waters. Preliminary analysis of the survey data wer made 6-7 September in Hammerfest. Observations concerning the geographical distribution of O-group fish and their abundance are given in this report together with a brief description of the hydrographical conditions in the area.

International Council for the Exploration of the Sea. Demersal Fish Committee. 1991. Preliminary report of the International 0-group Fish Survey in the Barents Sea and adjacent waters in August-September 1991. ICES CM 1991/G:50: 33 p.

International Council for the Exploration of the Sea. Demersal Fish Committee. 1992. Preliminary report of the International 0-group Fish Survey in the Barents Sea and adjacent waters in August-September 1992. ICES CM 1992/G:82: 33 p.

International Council for the Exploration of the Sea. Demersal Fish Committee. 1994. Preliminary report of the International 0-group Fish Survey in the Barents Sea and adjacent waters in August-September 1993. ICES CM 1994/G:3: 38 p.

International Council for the Exploration of the Sea. Demersal Fish Committee. 1995. Preliminary report of the International 0-group Fish Survey in the Barents Sea and adjacent waters in August-September 1994. ICES CM 1995/G:31: 36 p.

International Council for the Exploration of the Sea. Demersal Fish Committee. 1996. Preliminary report of the International 0-group Fish Survey in the Barents Sea and adjacent waters in August-September 1996. ICES CM 1996/G:31: 37 p.

International Council for the Exploration of the Sea. Demersal Fish Committee. 1996. Preliminary report of the International 0-group Fish Survey in the Barents Sea and adjacent waters in August-September 1995. ICES CM 1996/G:30: 37 p.

International Council for the Exploration of the Sea. Demersal Fish Committee. 1997. Report of the ICES/NAFO Workshop in Greenland Halibut Age Determination, Reykjavik, Iceland, 26-29 November 1996. ICES CM 1997/G:1: 53 p.

International Council for the Exploration of the Sea. Demersal Fish (Northern) Committee. 1968. Preliminary report of the 0-group fish survey in the Barents Sea and adjacent waters in August-September 1968. ICES CM 1968/F:33: 12 p.

International Council for the Exploration of the Sea. Demersal Fish (Northern) Committee. 1977. Report of the Working Group on Greenland halibut in Region 1. ICES CM 1977/F:4: 20 p.

International Council for the Exploration of the Sea. North-western Working Group. 1991. Report of the North-Western Working Group, Copenhagen, 1-8 May 1991. ICES CM 1991/Assess:21: 112 p.

International Council for the Exploration of the Sea. North-western Working Group 1992. The North-western Working Group, Copenhagen 2-12 May 1992. ICES CM 1992/Assess:14: 175 p.

International Council for the Exploration of the Sea. North-western Working Group. 1993. Report of the North-Western Working Group, Copenhagen, 3-11 May 1993. ICES CM 1993/Assess:18: 216 p.

International Council for the Exploration of the Sea. North-western Working Group. 1994. Report of the Working Group on assessment of pelagic stocks in the Baltic, Copenhagen, 13-21 April, 1994. ICES CM 1994/Assess:18: 337 p.

International Council for the Exploration of the Sea. North-western Working Group. 1995. Report of the North Working Group, ICES Headquarters, Copenhagen, Denmark, 3-10 May 1995. ICES CM 1995/Assess:19: 564 p.

International Council for the Exploration of the Sea. North-western Working Group 1996. Report of the North-Western Working Group, ICES Headquarters, Copenhagen Denmark, 1-8 May 1996. ICES CM 1996/Assess:15: 2 pts.

International Council for the Exploration of the Sea. North-western Working Group and ICES Advisory Committee on Fishery Management. 1998. Report of the North-Western Working Group, ICES Headquarters, 28 April-6 May 1998. ICES CM 1998/ACFM:19: 2 pts.

International Council for the Exploration of the Sea. North-western Working Group and ICES Advisory Committee on Fishery Management. 1999. Report of the North-Western Working Group, ICES Headquarters, 26 April-4 May 1999. ICES CM 1998/ACFM:17: 2 pts.

International Council for the Exploration of the Sea. North-western Working Group and ICES Advisory Committee on Fishery Management. 2000. Report of the North-Western Working Group, ICES Headquarters, 26 April-4 May 2000. ICES CM 2000/ACFM:15: 2 pts.

International Council for the Exploration of the Sea. North-western Working Group and ICES Advisory Committee on Fishery Management. 2001. Report of the North-Western Working Group, Torshavn, Faroe Islands, 24 April-3 May 2001. ICES CM 2001/ACFM:20: 427 p.

International Council for the Exploration of the Sea. North-western Working Group and ICES Advisory Committee on Fishery Management 2002. Report of the North-Western Working Group, ICES Headquarters, 29 April-8 May 2002. ICES CM 2002/ACFM:20: 416 p.

International Council for the Exploration of the Sea. North-western Working Group and ICES Advisory Committee on Fishery Management. 2003. Report of the North-Western Working Group, ICES Headquarters, 29 April-8 May 2003. ICES CM 2003/ACFM:24: 405 p.

International Council for the Exploration of the Sea. North-western Working Group and ICES Advisory Committee on Fisheries Management. 2004. Report of the North-Western Working Group, 27 April - 6 May 2004, ICES, Copenhagen. ICES CM 2004/ACFM:25: 476 p.

International Council for the Exploration of the Sea. Pelagic Fish Committee. 1978. Preliminary report of the International 0-group Fish Survey in the Barents Sea and adjacent waters in August-September 1978. ICES CM 1978/H:33: 25 p.

International Council for the Exploration of the Sea. Pelagic Fish Committee. 1984. Preliminary report of the International 0-group Fish Survey in the Barents Sea and adjacent waters in August-September 1984. ICES CM 1984/H:36.

International Council for the Exploration of the Sea. Pelagic Fish (Northern) Committee. 1971. Preliminary report of the International 0-group Fish Survey in the Barents Sea and adjacent waters in August-September 1971. ICES CM 1971/H:32: 14 p.

International Council for the Exploration of the Sea. Pelagic Fish (Northern) Committee 1973. Preliminary report of the International 0-group Fish Survey in the Barents Sea and adjacent waters in August-September 1972. ICES CM 1973/H:15: 15 p.

International Council for the Exploration of the Sea. Pelagic Fish (Northern) Committee 1973. Preliminary report of the International 0-group Fish Survey in the Barents Sea and adjacent waters in August-September 1973. ICES CM 1973/H:25: 26 p.

International Council for the Exploration of the Sea. Pelagic Fish (Northern) Committee 1974. Preliminary report of the International 0-group Fish Survey in the Barents Sea and adjacent waters in August-September 1974. ICES CM 1974/H:33: 23 p.

International Council for the Exploration of the Sea. Pelagic Fish (Northern) Committee 1975. Preliminary report of the International 0-group Fish Survey in the Barents Sea and adjacent waters in August-September 1975. ICES CM 1975/H:48: 23 p.

International Council for the Exploration of the Sea. Pelagic Fish (Northern) Committee 1976. Preliminary report of the International 0-group Fish Survey in the Barents Sea and adjacent waters in August-September 1976. ICES CM 1976/H:48: 25 p.

International Council for the Exploration of the Sea. Pelagic Fish (Northern) Committee. 1976. Preliminary report on the 0-group fish survey in Icelandic and Greenland waters in June-August 1976. ICES CM 1976/H:39: 22 p.

International Council for the Exploration of the Sea. Pelagic Fish (Northern) Committee. 1977. Preliminary report of the International 0-group Fish Survey in the Barents Sea and adjacent waters in August-September 1977. ICES CM 1977/H:45: 25 p.

International Council for the Exploration of the Sea. Study Group on Unaccounted Mortality in Fisheries. 1995. Report of the Study Group on Unaccounted Mortality in Fisheries, Aberdeen, Scotland 17-18 April 1995. ICES CM 1995/B:1: 27 p.

Isaksen, B., Valdemarsen, J.W., Larsen, R.B., and Karlsen, L. 1992. Reduction of fish by-catch in shrimp trawl using a rigid separator grid in the aft belly. Fish. Res. 13: 335-352.

In 1989 and 1990, a new concept to avoid the by-catch of fish in a shrimp trawl was developed in Norway. The system consists of a rectangular aluminium grid with longitudinal bars. The grid is installed in the extension piece, just in front of the cod-end, angled 48.degree., with a fish outlet on the top. In front of the grid a guiding funnel or flapper is mounted. Investigations into different grid sizes, bar distances, size of fish outlets, and guiding funnel or flapper constructions during practical tests, have led to several recommended measures. Smaller coastal shrimpers should use grids at least 0.7 m wide and 1.40 m long, while the bigger offshore trawlers should use a 1.0 m wide and 1.5 m long grid, both with a recommended bar separation of 19 mm, which gives an acceptable shrimp loss below 5%. RCTV-observations of the sorting grid system during fishing have shown that most of the shrimps (*Pandalus borealis*) passed in a straight line through the grid, while fish were guided upwards towards the fish outlet, either by swimming in front of the grid, or sliding along the bars. Some of the smaller fish passed through the grid and ended up in the cod-end. A combined speed and angle sensor, mounted just behind the grid, measured the horizontal speed of water through the grid to be 0.7 of the towing speed, and the angle of the grid, to be 3-5.degree. less than the theoretical mounting angle of 48.degree.. The separator grid allowed an increasing escape of cod (*Gadus morhua*) and haddock (*Melanogrammus aeglefinus*) up to a length of 20 cm, whereby all fish escaped. The 100% escape lengths for redfish (*Sebastes* sp.), long rough dab (*Hippoglossoides platessoides*), and polar cod (*Boreogadus saida*) were 18, 24 and 24 cm, respectively. The Greenland halibut (*Reinhardtius hippoglossoides*) gave a rather high 100% escape length of 30-32 cm, probably due to the behavior of this flatfish which swims on its side. The handling of the separator system has so far caused only minor problems, and the pre-sorting of fish by the separator grid results in less sorting work on deck. The separator grid was made compulsory in the northern coastal shrimp fishery from 1 March 1990, from 1 January 1992 in the offshore fisheries and will be compulsory in the Barents Sea [Arctic Ocean] and Spitsbergen waters from 1 January 1993.

Jakobsen, T., Korsbrekke, K., Mehl, S., and Nakken, O. 1997. Norwegian combined acoustic and bottom trawl surveys for demersal fish in the Barents Sea during winter. ICES CM 1997/Y:17: 26 p.

A combined acoustic and bottom trawl survey for demersal fish in the Barents Sea has been conducted annually since 1981. The main aim is to map the spatial distribution and obtain indices of abundance (numbers at age) of cod (*Gadus morhua)*, haddock (*Melanogrammus aeglefinus*), redfish (*Sebastes*) and Greenland halibut (*Reinhardtius hippoglossoides*). In addition other biological information and CTD-data are collected. The survey covers an area of about 150,000 square nautical miles, and is carried out with 3 vessels and about 25 scientific staff for a period of 25-30 days. The abundance indices and weight at age data are used directly in the stock assessments in ICES. Stomach data of cod are together with other information used to estimate the Northeast Arctic cod stock's consumption of important prey species, e.g. capelin (*Mallotus villosus*), cod and haddock. This information is further used in the assessment of these species. The tuning diagnostics indicate that the indices from the survey are the most reliable among the tuning data, and the assessments of Northeast Arctic cod and haddock are thus heavily dependent on the results of the survey. Since the management relies heavily on the assessments, the surveys can have a direct effect on the TAC's. Several changes in survey methodology aiming at increased reliability of the results have been introduced. Some of these changes had large effects on the index level. The time series have therefore been adjusted in order to maintain and improve comparability. However, it is suggested that also in the adjusted series, most recent years index/stock ratios for cod are higher than those from the first 10 years period; a matter that should be taken into account in the stock assessments.

Jensen, J.M. 1991. Denmark/Greenland research report for 1990. NAFO SCS documents 91/13: 8 p.

Jeremiassen, G. 2002. Denmark (Greenland) request for scientific advice on management in 2003 of certain stocks in Subareas 0 and 1. NAFO SCS documents 02/2: 1 p.

Jessen, A. 2003. Denmark (Greenland) request for scientific advice on management in 2004 of certain stocks in Subareas 0 and 1. NAFO SCS documents 03/3: 1 p.

Jessen, A. 2004. Denmark's (on behalf of Greenland) request for scientific advice on management of certain stocks in Subarea 0 and 1 in 2005. NAFO SCS documents 04/1: 1 p.

Jessen, A. 2005. Denmark's (on behalf of Greenland) request for scientific advice on management of certain stocks in Subarea 0 and 1 in 2005. NAFO SCS documents 04/1 Rev.: 1 p.

Jessen, A. 2005. Denmark (Greenland) request for scientific advice on management of certain stocks in Subarea 0 and 1. NAFO SCS documents 05/3: 1 p.

Johansen, P., Muir, D., Asmund, G., and Riget, F. 2004. Human exposure to contaminants in the traditional Greenland diet. Sci. Total Environ. 331: 189-206.

The traditional diet is a significant source of contaminants to people in Greenland, although contaminant levels vary widely among species and tissue from very low in many to very high in a few. Our study has included cadmium, mercury, selenium, polychlorinated biphenyls (PCB), dichlorophenyltrichloroethane (DDT), chlordane, hexachlorocyclohexanes (HCH), chlorobenzenes, dieldrin and toxaphene in the major species and tissues consumed by Greenlanders. In general, the levels of these are very low in terrestrial species and in muscle of many marine species. High organochlorines concentrations are typically found in blubber of marine mammals and high metal levels in liver and kidney of seals and whales. In this study, the mean intakes of cadmium, chlordanes and toxaphene significantly exceed 'acceptable/tolerable intakes' (ADI/TDI) by a factor between 2.5 and 6. Mean intakes of mercury, PCB and dieldrin also exceed ADI/TDI by up to approximately 50%. However as these figures are mean intakes and as variation in both food intake and contaminant levels is large, the variation of contaminant intake among individuals is also large, and some individuals will be exposed to significantly higher intakes. The mean intakes of DDT, HCH and chlorobenzenes are well below the ADI/TDI values, and it seems unlikely that the TDI for these contaminants normally is exceeded in the Greenland population. The evaluation of contaminant intake in this study points to seal muscle, seal liver, seal kidney, seal blubber and whale blubber as the dominant contributors of contaminants in the traditional diet. Levels in liver from Greenland halibut, snow crab, king eider, kittiwake, beluga and narwhal and kidney of beluga and narwhal are also high but were, with the exception of toxaphene in Greenland halibut liver, not important sources in this study, because they were eaten in low quantities. A way to minimize contaminant intake would be to avoid or limit the consumption of diet items with high contaminant levels. If we assume a traditional diet composition in this study without fish liver, bird liver, seal liver, seal kidney, seal blubber, whale liver, whale kidney and whale blubber, the intake of all contaminants would be below the TDIs for these. This will result in a reduction of the intake of the amount of traditional food of only 24-25%, and it is not likely that this changed diet will result in deficiency of minerals, vitamins or other nutritional compounds.

Johnson, A.G. 1977. A survey of biochemical variants found in groundfish stocks from North Pacific and Bering Sea. Anim. Blood Groups Biochem. Genet. 8: 13-20.

This report provides information on biochemical variants found in 16 spp. [T*heragra chalcogramma, Sebastes aleutianus, S. borealis, S. alutus, Anoplopoma fimbriata, Atheresthes stomias, Microstomus pacificus, Glyptocephalus zachirus, Hippoglossoides elassodon, Platichthyes stellatus, Hippoglossus sterolepsis, Lepidopsetta belineata, Limanda aspera, Reinhardtius hippoglossoides, Limanda probascidea, Pleuronectes quadrituberculatus*]. These variants may be useful in answering some of the questions facing fisheries agencies concerning stock separation, hybridization and life histories. Further studies should provide useful information in the areas of population biology of fishes in Alaskan waters.

Jonsson, S. 1995. Newfoundland and Iceland: a comparative development. *In* The North Atlantic fisheries: successes, failures and challenges. *Edited by* R.Arnason and L.Felt. University of Prince Edward Island. Institute of Island Studies, Charlottetown, PEI. pp. 267-286.

This paper compares the development of the fishing industries of Newfoundland and Iceland, and examines the role of the fishing industries in shaping the economy and society of the two islands. Newfoundland and Iceland are both sparsely populated fish exporting economies that have for a long time relied heavily on fisheries for their economic development. Intensive residential fisheries began in Newfoundland in the early 19th century; and in Iceland about a century later. In Newfoundland, during the inter-war period, diversification from the fisheries resource base began, with the growth of mining and lumbering, but in Iceland during this time diversification was slow, with the growth of commercial farming, manufacturing, and services.

Jørgensen, O. and Akimoto, K. 1990. Results of a stratified random bottom trawl survey in NAFO Subarea 1 in 1989. NAFO SCR documents 90/39: 14 p.

In April/May 1989 a stratified-random bottom trawl survey was carried out at West Greenland. The purpose of the survey was to estimate groundfish biomasses and to collect information on distribution, size composition and biology of major species off West Greenland. In 1989 the main interest was put upon Greenland halibut and roundnose grenadier. Beside information on catch distribution, biomass estimates and length distribution on Greenland halibut and roundnose grenadier the paper contains information on age composition, maturity and feeding rates of Greenland halibut.

Jørgensen, O. and Akimoto, K. 1991. Results of two trawl survey in NAFO subarea 1 in 1990. NAFO SCR documents 91/50: 14 p.

In June and August/September 1990 two trawl surveys were carried out at West Greenland by Japan Marine Resource Research Centre (JAMARC) in cooperation with Greenland Fisheries Research Institute. The surveys were part of a joint venture program started in 1987 between JAMARC and the Greenlandic Home Rule. The main purpose of the two surveys was to estimate groundfish biomasses and to collect information on distribution, size composition and biology of major species off West Greenland. As in 1988 and 1989 the main interest was put upon Greenland halibut (*Reinhardtius hippoglossoides)* and roundnose grenadier (*Coryphaenoides rupestris*). During both surveys a part of the survey time was used for pelagic fishing in order to investigate the pelagic distribution of Greenland halibut, roundnose grenadier and redfish.

Jørgensen, O. and Boje, J.1993. An assessment of the Greenland halibut stock component in NAFO Subareas 0+1. NAFO SCR documents.93/80: 6 p.

In the period 1981-1989 nominal catches of Greenland halibut (*Reinhardtius hippoglossoides*) in Subareas 0+1 have been rather stable with an annual average of 9,000 tons. Since 1989 catches have increased considerably to about 20,000 tons in 1990, 22,000 tons in 1991 and 28,501 tons in 1992. The increase in catches from 1989 to 1990 was mainly due to a new trawl fishery by Canada in Division OB, while the increase from 1991 to 1992 was due to a general increase in the catches in Subarea 0 and 1 both in- and offshore.

Jørgensen, O. and Boje, J.1994. Sexual maturity of Greenland halibut in NAFO Subarea 1. NAFO SCR documents 94/42: 17 p.

In order to clarify the spawning dynamics of Greenland halibut in Greenland waters maturity data was sampled in the period 1988-1994. Sampling was carried out during different seasons of the year, inshore in Divisions 1A and offshore in Divisions 1A-1D by means of longline and trawl. In total 4077 and 14442 Greenland halibut were sampled inshore and offshore, respectively. The relative weight of the gonads were used as a gonadosomatic index value for the sexual maturation of the fish. In the inshore areas high index values were obtained in some years for some fjord systems, indicating that spawning probably takes place sporadically, independently from one fjord to another. As catch compositions of the commercial fishery are stable throughout the year, there is no signs of a spawning migration from the fjords to the Davis Strait. For the offshore area Greenland halibut reached lowest and highest index values in the second and fourth quarter, respectively. Only a few percent of the fish matured in Div. 1A while more than 50% of the fish matured in Div. 1D, indicating that spawning takes place in the deeper central part of the Davis Strait in winter and early spring.

Jørgensen, O.A. 1994. Offshore distribution pattern of Greenland halibut (*Reinhardtius hippoglossoides* (Walb.), at West Greenland. NAFO SCR documents 94/17: 20 p.

The main spawning area for Greenland halibut (*Reinhardtius hippoglossoides*) in the Davis Strait is located at great depths south of 67 degrees N. The present paper documents that these migrations in fact take place at West Greenland and shows a seasonality in the distributioin of Greenland halibut that is related to spawning migration.

Jørgensen, O.A. 1995. A comparison of deep water trawl and long-line research fishing in the Davis Strait. *In* Deep-water fisheries of the North Atlantic oceanic slope. *Edited by* A.G.Hopper. Kluwer Academic Publisheres, Dordrecht, The Netherlands. pp. 235-250.

In August 1991 a long-line and a bottom trawl comparative survey, covering depths between 950 and 1450 m, was conducted off west Greenland. Great differences in catch composition and length frequency of Greenland halibut (*Reinhardtius hippoglossoides*) and roughhead grenadier (*Macrourus berglax*) were observed in the two types of gear. Calculation of relative selection (RS) of Greenland halibut showed that long-lines were up to 30 times more effective in catching large fish, and fishing with long-lines by comparison to the trawl allows a greater maximum sustainable yield (MSY). The RS for roughhead grenadier showed that the long-lines were about 18 times more effective for this species up to 71 cm total length but there is probably a drop in the RS for the very large fish. These results tend to confirm previous work in this field suggesting that for Greenland halibut in particular the long-line is probably the best method of fishing. Roundnose grenadier were present in large numbers in the trawl but totally absent from the longline catches.

Jørgensen, O.A. 1997. Assessment of the Greenland halibut stock component in NAFO Subareas 0 + Div.1B-1F. NAFO SCR documents 97/53: 10 p.

Since catches of Greenland halibut, *Reinhardtius hippoglossoides*, in NAFO Subarea 0 + Div.1B-1F, peaked at 18,000 tons in 1992 they have been stable at around 11,000 tons. The age composition in the catches seems stable. The recruitment has declined compared to the presumably good 1991 year class but increased again and the 1995 year class seems to be the largest in the time series. Standardized catch rates declined further in 1996, but the 1996 data are considered poor. A Norwegian unstandardized catch rate series showed a slight increase between 1995 and 1996.

Jørgensen, O.A. 1997. Movement patterns of Greenland halibut, (*Reinhardtius hippoglossoides* (Walbaum)), at West Greenland, as inferred from trawl survey distribution and size data. J. Northwest Atl. Fish. Sci. 21: 23-27.

During 1988-93, several bottom trawl surveys were conducted in West Greenland covering depths from 38 to 497 m. The movement of Greenland halibut (*Reinhardtius hippoglossoides*) (Walbaum) from important nursery grounds west and southwest of

Disko Island towards greater depths and towards the spawning area further south in the Davis Strait were inferred by statistically significant changes in mean lengths by area and depth. Surveys were conducted at different times of the year during April-December. The spatial distribution of Greenland halibut apparently changes considerably throughout the year based on contour maps of estimated stock density. Migration between areas is likely related to significant changes in stages of maturity during the year. Bottom temperature does not appear to have significant influence on stock movements and distribution.

Jørgensen, O.A. 1997. Pelagic occurrence of Greenland halibut, *Reinhardtius hippoglossoides* (Walbaum), in West Greenland waters. J. Northwest Atl. Fish. Sci. 21: 39-50.

The extent of pelagic occurrence of Greenland halibut, *Reinhardtius hippoglossoides* (Walbaum), in Greenland waters was evaluated from four pelagic surveys, two conducted at deep water areas where the commercial fishery takes place and two in areas considered to be important nursery areas. The results from the pelagic surveys are compared to results from bottom trawl surveys conducted in the same areas and at the same time. Pelagic behaviour was further supported by investigations of stomach contents from Greenland halibut sampled during pelagic and bottom surveys, and by analysis of commercial bottom trawl data. One-year-old Greenland halibut were abundant and they undertook vertical feeding migrations at night. Older Greenland halibut were rarely encountered pelagically, and the analysis of commercial trawl data showed that the catchability of Greenland halibut did not vary diurnally.

Jørgensen, O.A. 1997. Results of the joint Japan/Greenland bottom trawl surveys at West Greenland during 1987-95 of Greenland halibut (*Reinhardtius hippoglossoides*, Walbaum). NAFO SCR documents 97/21: 24 p.

During the period 1987-1995 Japan Marine Fishery Resources Research Center and Greenland Institute of Natural Resources jointly conducted 12 stratified random trawl surveys at West Greenland. The surveys covered the area between Cap Farewell and 72 degree 51'N at depths down to approximately 1500 m depth. The survey area has been restratified in 200 m depth intervals and the biomass and abundance of Greenland halibut has been recalculated and the results of all surveys are presented together with information on length, age and sex distribution and catches in relation to bottom temperature.

Jørgensen, O.A. 1998. Assessment of the Greenland halibut stock component in NAFO Subarea 0 + Div. 1A + Div. 1B - 1F. NAFO SCR documents 98/56: 16 p.

Between 1979 and 1994 a TAC for Greenland halibut (*Reinhardtius hippoglossoides*), has been set at 25,000 tons for SA 0+1, including Div. 1A inshore. In 1994 it was decided to make separate assessments for the inshore area in Div. 1A and SA 0 + Div. 1A offshore + Div. 1B-1F. From 1995-1998 a TAC for this area was set at 11,000 tons. In the period 1982-1989 nominal catches of Greenland halibut in SA 0 + Div. 1A offshore and Div. 1B-1F fluctuated between 300 and 4,500 tons. Catches increased from 2,200 in 1989 tons to 10,500 in 1990. Catches stayed at that level in 1991 but increased again in 1992 to 18,100, the highest in the time series. Since then catches have been about 11,000 tons. In 1997 catches were 10,540 compared to 10,430 tons in 1996. The increase in catches from 1989 to 1990 was mainly due to a new trawl fishery by Canada and Norway in Div. 0B, while the increase from 1991 to 1992 was due to the introduction of a trawl fishery by Russia in Div. 0B and an increase in fishing activity in SA 1. Since catches peaked in 1992 they have been stable at around 10,500 tons. The age composition in the catches seems stable. Standardized catch rates in both 0B and 1CD have increased from 1996 to 1997. The catch rates seem to be at a high level in 0B and around average in 1CD. An unstandardized longline CPUE index showed a decrease from 1995 to 1997. Recruitment has declined markedly compared to the large 1995 year class and the 1996 year class seems to be below average for the period 1988-1997.

Jørgensen, O.A. 1998. Results of the joint Japan-Greenland trawl surveys at West Greenland 1987-95 on Greenland halibut (*Reinhardtius hippoglossoides*) and Roundnose Grenadier (*Coryphaenoides rupestris*). Northwest Atl. Fish. Organ. Sci. Counc. Stud. 31: 21-56.

During the period 1987-95 Japan Marine Fishery Resources Research Center and Greenland Institute of Natural Resources jointly conducted 12 stratified random bottom trawl surveys and 4 pelagic surveys at West Greenland. The bottom trawl surveys covered the area between Cape Farewell and 72[deg]51'N down to depths approximately 1 500 m. The survey area was restratified in 200 m depth intervals and the biomass and abundance of Greenland halibut (*Reinhardtius hippoglossoides* Walbaum) and roundnose grenadier (*Coryphaenoides rupestris* Gunnerus) were recalculated. The results of all surveys are presented together with information on length, age and sex distribution and, for Greenland halibut, catches in relation to bottom temperature. Roundnose grenadier was recorded in 2 of the pelagic surveys and the vertical distribution was analyzed based on 59 pelagic hauls covering the entire water column at all times of the day. The length distributions from pelagic trawl hauls were compared to those from bottom hauls.

Jørgensen, O.A. 1998. Survey for Greenland halibut in NAFO Divisions 1C-1D. NAFO SCR documents 98/25: 26 p.

During the period 1987-1995 Japan Marine Fishery Resources Research Center (JAMARC) and Greenland Institute of Natural Resources jointly conducted 12 bottom trawl surveys and 4 pelagic surveys at West Greenland as part of a joint ventury agreement on fisheries development and fisheries research in Greenland waters. The bottom trawl surveys were primarily aimed at Greenland halibut (*Reinhardtius hippoglossoides*) off West Greenland. In 1997 Greenland Institute of Natural Resources continued the bottom trawl surveys series with the Institute's own vessel PAAMIUT which had been rigged for deep sea trawling. There has unfortunately not been any comparative trawlings between the Japanese research vessel SHINKAI MARU and PAAMIUT making comparisons between the surveys difficult.

Jørgensen, O.A. 1999. Assessment of the Greenland halibut stock component in NAFO Subarea 0 + Div.. 1A offshore + Div. 1B-1F. NAFO SCR documents 99/53: 16 p.

This paper presents the background and the input parameters from research surveys and the commercial fishery to the assessment of the Greenland halibut *(Reinhardtius hippoglossoides*) stock component in NAFO Subarea 0 + Div. 1A offshore + Div. 1B-1F. Catches peaked at 18,000 tons in 1992 but have been stable around 10,500 tons since. The catch composition has been stable in recent years. Survey trawlable biomass in Div. 1CD was in 1998 estimated at 70,000 tons which is an increase from the 56,000 estimated in 1997. Recruitment estimates at age 1 of the 1992-94 year-classes were lower than the presumably good 1991 year-class, but are still considered to be at or above average for the last decade. The 1995 year-class was estimated to be the best in the series. The 1996 and 1997 year-classes were estimated to be slightly below the average of the last decade. A combined standardized CPUE index from Div. 0B and Div. 1CD has been stable during 1990-98. Although the survey series from 1987-1995 is not directly comparable with the series from 1997-1998 the decline in the stock observed in Subarea 1 until 1994 has stopped and the stock seems to be back at the level in the late-1980s and early-1990s.

Jørgensen, O.A. 1999. Survey for Greenland halibut in NAFO Divisions 1C-1D, 1998. NAFO SCR documents 99/30: 13 p.

In 1997 Greenland initiated a survey series covering NAFO Div. 1CD at depths between 400 and 1500 m. the survey is designed as a Stratified Random Bottom Trawl Survey mainly aimed at Greenland halibut and roundnose grenadier. In 1998 56 tows were made. The paper gives biomass estimates, abundance estimates and length frequencies for Greenland halibut, roundnose grenadier, roughhead grenadier, deep-sea redfish, and American plaice, together with age and maturity data for Greenland halibut. The biomass of Greenland halibut increased from 56,000 tons in 1997 to 70,000 in 1998. The biomass of roundnose grenadier also increased slightly, but is still at a very low level compared to the late 1980s.

Jørgensen, O.A. 2000. Assessment of the Greenland halibut stock component in NAFO subarea 0 + div. 1A offshore + divisions 1B - 1F. NAFO SCR documents 00/38: 20 p.

This paper presents the background and input parameters from research surveys and the commercial fishery to the assessment of the Greenland halibut (*Reinhardtius hippoglossoides*) stock component in NAFO Subarea 0 + Div. 1A offshore + Div. 1B - 1F. Catches peaked at 18,000 tons in 1992 but have been stable around 10,000 tons since then. The catch composition has been stable in recent years. Survey trawlable biomass in Div. 1CD was estimated at 64,000 tons in 1999, which is a minor decrease from 70,000 tons estimated in 1998. In a new survey covering Div. 0A the biomass was estimated at 83,000 tons. Recruitment estimates at age 1 of the 1992-1994 year classes were lower than the presumably good 1991 year-class, but are still considered to be at or above average for the last decade. The 1995 year-class was estimated to be the best in the series. The 1996 and 1997 year-classes were estimated to be slightly below the average of the last decade while the 1998 year-class is above. A combined standardised CPUE index from Div. 0B and Div. 1CD has shown a minor decline compared to 1998 but the index has been stable during 1990-99. The decline in the stock observed in Subarea 1 until 1994 has stopped, and the stock seems to be back to the late 1980s and early 1990s levels.

Jørgensen, O.A. 2000. Survey for Greenland halibut in NAFO Divisions 1C-1D, 1999. NAFO SCR documents 00/10: 26 p.

In 1997 Greenland initiated a survey series covering NAFO Div. 1CD at depths between 400 and 1500 m. The survey is designed as a Stratified Random Bottom Ttrawl Survey mainly aimed at Greenland halibut and roundnose grenadier. In 1999 only 38 or the 70 planned tows were made due to bad weather. The paper gives biomass and abundance estimates and length frequencies for Greenland halibut, roundnose and roughed grenadier, deep-sea redfish and American plaice, together with age and maturity data for Greenland halibut. The biomass of Greenland halibut was estimated at 64,000 tos which is a slight decrease compared to 70,000 tone in 1998 but above the estimate at 56,000 tons in 1997. The biomass of roundnose was estimated at 2,700 tons which is the lowest on record.

Jørgensen, O.A. 2001. Assessment of the Greenland halibut stock component in NAFO Subarea 0+ Division 1A Offshore + Divisions 1B-1F. NAFO SCR documents 01/48: 14 p.

The paper presents the background and the input parameters from research surveys and the commercial fishery to the assessment of the Greenland halibut (*Reinhardtius hippoglossoides*) stock component in NAFO Subarea 0 + Div. 1A offshore +Div. 1B-1F. Catches peaked at 18,000 tons in 1992 but have been stable around 10,000 tons since then. The catch composition has been stable in recent years. Survey trawlable biomass in Div. 1CD was estimated in 1999 as 59,000 tons, which is a minor decrease from 70,000 tons estimated in 1998. In a new survey covering Div. 0B the biomass was estimated at 56,000 tons. Recruitment estimates at age 1 of the 1992-94 year-classes were lower than the presumably good 1991 year-class, but are still considered to be at or above average for the last decade. The 1995 year-class was estimated to be the best in the series. The 1996 and 1997 year-classes were estimated to be slightly below the average of the last decade while the 1998 and 1999 year-classes are above. A combined standardised CPUE index from Div. 0 and Div. 1CD has showed a minor increase compared to 1999, but the index has been stable during 1990-2000.

Jørgensen, O.A. 2001. Survey for Greenland halibut in NAFO Divisions 1C-1D, 2000. NAFO SCR documents 01/23.

In 1997 Greenland initiated a survey series covering NAFO Divisions 1CD at depths between 400 and 1,500 m. The survey is designed as a Stratified Random Bottom Trawl Survey mainly aimed at Greenland halibut and roundnose grenadier. The paper gives biomass and abundance estimates and length frequencies for Greenland halibut, roundnose and roughhead grenadier, together with age and maturity data for Greenland halibut. The biomass of Greenland halibut was estimated as 59,000 tons, which is a slight decrease, compared to 64,000 tons in 1999. the biomass of roundnose grenadier was estimated as 5,600 tons. Only 30 of the 70n planed tows were made due to bad weather.

Jørgensen, O.A. 2002. Assessment of the Greenland halibut stock component in NAFO Subarea 0 + Div. 1A Offshore + Div.1B-1F. NAFO SCR documents 02/67: 16 p.

This paper presents the background and the input parameters from research surveys and the commercial fishery to the assessment of the Greenland halibut (*Reinhardtius hippoglossoides*) stock component in NAFO Subarea 0 + Div. 1A offshore + Div.1B-1F. Catches peaked at 18,000 tons in 1992 but have been stable around 10,000 tons since then, but increased to 13,285 in 2001, primarily due to increased effort in Div. 0A. The catch composition has been stable in recent years. Survey trawlable biomass in Div. 1CD was in 2001 estimated at 77,500 tons, which is the highest in the five year survey series. Surveys in Div. 0A and 0B also showed an increase in biomass. In Div. 0A biomass increased from 83,000 tons in 1999 to 97,500 tons in 2001, and in Div. 0B from 56,000 tons in 2000 to 69,000 tons in 2001. The biomass in a new survey in Div. 1 recruitment of age one has been increasing during the latest years and the 2000 year-class was estimated as the largest in the time series, which dates back to 1988. A standardised CPUE index from Div. 1CD has shown a minor increase during 1999-2001 and CPUE was slightly above the average for the 1990-2001 period. An unstandardized CPUE from the single-trawl fishery in Div 0A showed a slight increase compared to 2000 and catch rates were at an average level for the period 1996-2001.

Jørgensen, O.A. 2002. Survey for Greenland halibut in NAFO Divisions 1A-1D, 2001. NAFO SCR documents 02/30: 31 p.

In 1997 Greenland initiated a survey series covering NAFO Div. 1CD at depths between 400 and 1 500 m. The survey is designed as a Stratified Random Bottom Trawl Survey aimed mainly at Greenland halibut and roundnose grenadier. In 2001 the survey area was expanded to include NAFO Div. 1A and 1B. The paper gives biomass and abundance estimates and length frequencies for Greenland halibut, roundnose and roughed grenadier and deep-sea redfish, together with age and maturity data for Greenland halibut. The biomass of Greenland halibut was estimated as 140 000 tons of which 77 600 tons was found in Div. 1CD, compared to 59 000 tons in 2000. The biomass of roundnose grenadier was estimated as only 1 600 tons.

Jørgensen, O.A. 2003. Assessment of the Greenland halibut stock component in NAFO Subarea 0 + Division 1A offshore + Divisions 1B - 1F. NAFO SCR documents 03/53: 17 p.

This paper presents the background and the input parameters from research surveys and the commercial fishery to the assessment of the Greenland halibut (*Reinhardtius* *hippoglossoides)* stock component in NAFO Subarea 0 + Div. 1A offshore + Div. 1B - 1F. Catches peaked at 18 000 tons in 1992 but have been stable around 10 000 tons during 1993-2000. Catches increased to 13 285 tons in 2001, primarily due to increased effort in Div. 0A and further to 15 136 tons in 2002, primarily due to increased effort in Div. 1A. The catch composition has been stable in recent years. Survey trawlable biomass in Div. 1CD was in 2002 estimated at 72 000 tons, which is the second highest in the six year survey series. The recruitment of age one has been increasing during the latest years but decreased to a level a little below average for the time series, which dates back to 1988. A standardised CPUE index from Div. 1CD has shown a minor decrease between 2001 and 2002 but CPUE was about average for the 1990-2002 period. An unstandardized CPUE from the single-trawl and twin trawl fishery in Div. 0A showed an increase compared to 2001.

Jørgensen, O.A. 2003. Survey for Greenland halibut in NAFO Divisions 1C-1D, 2002. NAFO SCR documents 03/20: 25 p.

Jørgensen, O.A. 2004. Assessment of the Greenland halibut stock component in NAFO Subarea 0 + Division 1A offshore + Divisions 1B-1F. NAFO SCR documents 04/45: 16 p.

The paper presents the background and the input parameters from research surveys and the commercial fishery to the assessment of the Greenland halibut (*Reinhardtius hippoglossoides*) stock component in NAFO Subarea 0 + Div. 1A offshore + Div. 1B-1F. Catches peaked at 18,000 tons in 1992 but have been stable around 10,000 tons during 1993-2000. Catches increased to 13,284 tons in 2001 and further to 15,136 tons in 2002, primarily due to increased effort in Div. 0A and 1A. Catches increased again in 2003 to 19,954, primarily due to increases in catches in Div. 0B and 1A. Survey trawlable biomass in Div. 1CD was in 2003 estimated at 69,000 tons compared to 72,000 tons in 2002 and a little above the average for the time series. The recruitment of age one has been increasing during the latest years but decreased in 2002 to a level a little below average. Recruitment increased again in 2003 to a level above average for the time series, which dates back to 1988. A standardised CPUE index from Div. 1CD has shown a minor increase between 2002 and 2003 to a level a little above average for the 1990-2002 period. An unstandardized CPUE from the single-trawl and twin trawl fishery in Div 0A showed a further increase compared to 2001 and 2002.

Jørgensen, O.A. 2004. Survey for Greenland halibut in NAFO Divisions 1C - 1D, 2003. NAFO SCR documents 04/19: 26 p.

In 1997 Greenland initiated a survey series covering NAFO Divisions 1CD at depths between 400 and 1 500 m. The survey is designed as a Stratified Random Bottom Trawl Survey aimed mainly at Greenland halibut (*Reinhardtius hippoglossoides*) and roundnose grenadier (*Coryphaenoides rupestris*). The paper gives biomass and abundance estimates and length frequencies for Greenland halibut, roundnose and roughhead grenadier (*Macrourus berglax*), and deep sea redfish (*Sebastes* spp.) together with age and maturity data for Greenland halibut. The biomass of Greenland halibut was estimated as 68 700 tons compared to 72 000 tons. The biomass of roundnose grenadier was estimated as 774 tons only.

Jørgensen, O.A. 2005. Assessment of the Greenland halibut stock component in NAFO Subarea 0 + Division 1A offshore + Divisions 1B-1F. NAFO SCR documents 05/51: 21 p.

The paper presents the background and the input parameters from research surveys and the commercial fishery to the assessment of the Greenland halibut stock component in NAFO Subarea 0 + Div. 1A offshore + Div. 1B-1F. Catches peaked at 18 000 tons in 1992 but have been stable around 10 000 tons during 1993-2000. Catches increased to 13 184 tons in 2001 and further to 19 954 tons 2003 primarily due to increases in catches in Div.

0A and 1A. Catches dropped slightly in 2004 to 19,098 tons. Survey trawlable biomass in the southern part of Div. 0A increased between 2001 and 2004 when it was estimated at 86,000 tons. In a new Canadian survey in the northern part of Div. 1A the biomass was estimated as 46,000 tons. Survey trawlable biomass in Div. 1CD increased between 2003 and 2004 to 76.000 tons which is above the average for the time series. The biomass in a new Greenland survey in the northern part of Baffin Bay (Div. 1A) was estimated as 54 000 tons. The recruitment of age one has been above average in resent years for the time series, which dates back to 1988. A standardised CPUE index from Div. 1CD has been stable since 1990.

Jørgensen, O.A. 2005. Survey for Greenland halibut in NAFO Divisions 1C-1D, 2004. NAFO SCR documents 05/13.

In 1997 Greenland initiated a survey series covering NAFO Divisions 1CD at depths between 400 and 1 500 m. The survey is designed as a Stratified Random Bottom Trawl Survey aimed mainly at Greenland halibut and roundnose grenadier. The paper gives biomass and abundance estimates and length frequencies for Greenland halibut, roundnose and roughhead grenadier, and deep sea redfish together with age and maturity data for Greenland halibut. The biomass of Greenland halibut was estimated as 75 900 in 2004 compared to 68 700 tons in 2003. The biomass of roundnose grenadier was estimated as 633 tons only.

Jørgensen, O.A. 2005. Survey for Greenland halibut in the northern part of Baffin Bay, NAFO Division 1A, 2004. NAFO SCR documents 05/14: 12 p.

In 2001 Greenland conducted a bottom trawl survey in the southern part of Baffin Bay to 74°N, primarily aimed at Greenland halibut, which was found all over the area, except at shallow water. In 2004 the area between 73°N and 77°N was surveyed down to 1 500 m. Greenland halibut was also observed all over the northern part of the Baffin Bay and the trawlable biomass was estimated as 53 900 tons. Greenland halibut was the only species of commercial interest that was found in noticeable amounts. Canada conducted a similar survey in the Canadian part of Baffin Bay.

Jørgensen, O.A. and Bech, G. 1996. Assessment of the Greenland halibut stock component in NAFO Subarea 0 + Divisions 1B-1F. NAFO SCR documents 96/67: 13 p.

In the period 1982-1989 nominal catches of Greenland halibut (*Reinhardtius hippoglossoides*) in Sub. 0+Div. 1B-1F fluctuated between 300 and 4,500 tons. Catches increased from 2,200 in 1989 tons to 15,500 in 1990. In 1991 catches dropped to 11,000 tons and then increased to 18,000 tons in 1992, the highest in the time series. Since catches peaked with 18,000 tons in 1992 they have been stable at around 11,000 tons. The estimated biomass showed an increase from 31,000 in 1994 to 41,000 tons in 1995 and seems to have stabilized, on, however, a lower level compared to the late 80s and early 90s. The recruitment has declined compared to the 1991 year class, but is still considered to be at or above average for the last decade. The 1991 year class was still considered to be good at age 4 and will enter the trawl fishery in 1996 and 1997. Although incomplete three out of four available CPUE indices showed an increase.

Jørgensen, O.A. and Boje, J.1992. A comparison of the selectivity in trawl and long-line fishery for Greenland halibut. NAFO SCR documents 92/53: 5 p.

Jørgensen, O.A. and Boje, J.1995. Assessment of the Greenland halibut stock component in NAFO Subarea 0 + Divisions 1B-1F. NAFO SCR documents 95/68: 16 p.

After 1989 the offshore fishery for Greenland halibut (*Reinhardtius hippoglossoides*) in subareas 0+1 (Div 1B-F) has expanded considerably. This increased exploitation is expected to cause a change in the stock composition in the area towards younger fish and a lower total biomass. The decline both in the commercial catch rates and in the survey biomass are however marked and suggests a high exploitation level.

Jørgensen, O.A. and Carlsson, D.M. 1998. An estimate of by-catch of fish in the West Greenland shrimp fishery based on survey data. NAFO SCR documents 98/41: 20 p.

The catches in the West Greenland northern shrimp (*Pandalus borealis*) fishery have been rather stable around 40-70 000 tons annually during the last two decades. The amount of by catch of fish in the shrimp fishery can not be estimated directly because the by catch figures in the logbooks are considered unreliable. In the past there have been several attempts to estimate the by catch from survey data and a few direct observations from the commercial fishery made by the staff from Greenland Institute Natural Resouces. Investigations indicate that the by catch of small Greenland halibut (*Reinhardtius hippoglossoides*) and small redfish (*Sebastes* spp.) might be considerable. In the present paper the by catch of a number of fish species in the commercial shrimp fishery in July-August is estimated from a stratified bottom trawl conducted in the same period in NAFO Subarea 1. The overlap between the distribution of the shrimp stock and Greenland halibut and redfish stocks implies that the problem with by catches in the shrimp fishery can not be solved by closing certain areas. The only way to solve the problem is by technical solution such as separator grids. In the near future separator grids (bar width 22 mm) will be mandatory on all larger offshore shrimp trawlers.

Junge, G., Strebelow, G., and Voss, J. 1982. Selection experiments with cod-ends of different mesh sizes in fisheries of grenadier (*Macrourus rupestris*) and Greenland halibut (*Reinhardtius hippoglossoides).* ICES CM 1982/B:31: 12 p.

Junge, G., Strebelow, G., and Voss, J. 1982. Selectivity tests using cod-ends of different mesh sizes in the fishery for grenadier (*Macrurus rupestris*) and Greenland halibut (*Reinhardtius hippoglossoides*) [Selectivitatsuntersuchungen mit steerten unterschiedlicher maschenoffnungen in der fischerei auf Grenadierfisch (*Macrourus rupestris*) und schwarzem heilbutt (*Reinhardtius hippoglossoides*). Can. Transl. Fish. Aquat. Sci. 4886(2): pp. 8-35.
[Translated from German; original appeared in Fischereibericht der DDR zur abfischung der nationalen quoten 1981 in der Kanadischen fischereizone. VEB Fischfang Rostock Direktionsberich Fang Abt.FVR, 1982]

As an exploiter of several fishing grounds in Canada's fishing zone off the coasts of Labrador and Newfoundland, the deep-sea fishing industry of the German Democratic Republic has been endeavouring for years to obtain scientific data to aid the measures being taken to protect and preserve the fish stocks in question. In 1981, in the course of these efforts and in agreement with the Canadian fishing authorities, the deep-sea fishing industry of the GDR examined to what extent the establishment of a minimum mesh size influences the effectiveness of measures being taken to protect and preserve the grenadier and halibut stocks within Canadian fishing zone off the coasts of Labrador and Newfoundland.

Junquera, S. 1993. Feeding cycles of Greenland halibut (*Reinhardtius hippoglossoides*) in the Flemish Pass area in relation to catch rates (1991-92). NAFO SCR documents 93/17: 11p.

The seasonal cycle in feeding activity of Greenland halibut shows a maximum in autumn in depths between 700-900 m. In deeper waters no seasonality appears at all. A 24-hour cycle in feeding activity is observed which is length related, with a day- time (6-12 hour interval) maximum in smaller fish (<60 cm) and at both sunset and night (18-24 hour and 0-6 hour intervals) in the largest fish (<80 cm). The intermediate length class (60-80 cm) shows a minimum in feeding activity in the afternoon (12-18 h) and in general a maximum in the interval 6-12 h, but in this group significant feeding activity occurs also at night. Catch rates decrease in autumn and reach a maximum in winter. In winter, increased catches occurs mainly at night (0-6 h interval) and are based mainly in the smallest length class (<60 cm), which feeds least during this time interval. An inverse relationship between feeding intensity and catch rates has been observed.

Junquera, S. 1994. Analysis of the variations in the spacial distribution and spawning of the Greenland halibut in Divisions 3LMN (1990-93). NAFO SCR documents 94/25: 12 p.

In this paper the geographic, bathymetric and seasonal distribution of the adult Greenland halibut stock exploited in the Flemish Pass area (Div. 3LMN) is analysed for the period 1990-1993 using data collected by observers on board the commercial fleet. A southward shift of the fishing area took place and adult fish and spawning activity were recorded in unusual areas. The main areas and seasons of spawning are described. A peak time for spawning has not been found and spawning females appeared evenly represented at any time of the day.

Junquera, S. 1995. Effect of the feeding activity on the catch rates in the Greenland halibut (*Reinhardtius hippoglossoides*) fishery in Flemish Pass area (1991-92). Northwest Atl. Fish. Organ. Sci. Counc. Stud. 23: 55-64.

Feeding activity of Greenland halibut (*Reinhardtius hippoglossoides*) was compared with the trends in catch rates of the commercial fishery on a seasonal and 24-hr per day basis in the Flemish Pass area in NAFO Div. 3LM and northern part of Div. 3N. The percentage of empty stomachs (PES) was taken as the index of feeding activity. A diel cycle in feeding activity was observed to be related to length, with a day-time (0600-1200 hr interval) maximum in smaller fish (<60 cm) and at evening-night (1800-2400 hr and 0000-0600 hr intervals) in the largest fish (>80 cm). Seasonal variations in the PES, that matched the seasonal pattern of variation in catch rates, were only observed in depths between 700-899 m. In deeper waters no seasonality appeared at all. Feeding activity increased with both depth and size of the fish. Catch rates decreased in autumn, but reached a maximum in winter. In the winter, increased catches occurred mainly at night (0000-0600 hr interval) and were based on the smallest length-class (<60 cm) which feeds the least during this time interval. An inverse relationship between feeding activity and fish availability is proposed.

Junquera, S. 2001. Standardized CPUE indices for Greenland halibut and American plaice in NAFO Division 3LMNO bassed on Spanish commercial catch rates. NAFO SCR documents 01/164: 4 p.

Standardized CPUE series using a Generalized Linear Model for Greenland halibut and American plaice in Division 3LMNO, based on catch and effort data from the Spanish trawl fleet since 1990 at depth inervals are presented. In the case of the Greenland halibut series, the largest proportion of the variance (45%) is explained by the factor 'depth', while in the American plaice on it is the factor 'vessel' (51%). The general trend observed in the Greenland halibut standardized CPUE in all divisions is a sharp increase in the indices from about 600 m, attaining maximum values between 900-1000 m, and then decreasing at depths beyond 1200 m. American plaice CPUE values at depths less than 500 m are very small in all division. The American plaice CPUE series show two peaks one between 100-200 m and the other between 400-500 m, decreasing sharply thereaafter. The larger values in this species are observed in Div. 3L and 3N, while very small ones are in Div. 3M at any depth.

Junquera, S. and Saborido-Rey, F. 1995. Histological assessment of sexual maturity in Greenland halibut in Div. 3LM. NAFO SCR documents 95/28: 9 p.

In order to clarify the seasonal maturation dynamics and the type of reproductive strategy in female Greenland halibut, (*Reinhardtius hippoglossoides*) this paper presents the results from the analysis of ovaries over a three-year cycle using standard histological techniques.

Junquera, S. and Saborido-Rey, F. 1995. Temporal and spatial variation in length at maturity in 3LM and 3NO Greenland halibut. NAFO SCR documents 95/29: 6 p.

It is essential for stock management to be able to determine the length or age of fish maturity. This parameter has already been estimated for the Greenland halibut stock in different NAFO areas and time periods. In recent years, two features are remarkable in the Greenland halibut stock in Subareas 2 and 3: one is the apparent reduction in stock abundance, shown by the results of the Canadian surveys. The other is that there are indications of a major redistribution of the stock with the presence of adult fish in areas where only juveniles were previously found. It is a known fact that a reduction in population densities affect the reproductive parameters, mainly the length at maturity. This paper reviews the trends for this parameter from 1990 to the present, with a view to evaluating the effect of these events in the stock.

Junquera, S. and Zamarro, J. 1992. Sexual maturity and spawning of the Greenland halibut (*Reinhardtius hippoglossoides*) from Flemish Pass area. NAFO SCR documents 92/41: 10 p.

In this paper we deal with the description of reproductive aspects of the Greenland halibut in the Flemish Pass area, based on data supplied by observers on board the Spanish commercial fleet. Its interests rely on the one hand in that they provide long lasting systematic sampling all year round and on the other hand, on their activity in deep waters (800-1700 meters) and areas from were there was no information available until now, so clarifying unknown aspects of the biology and dynamics of this species.

Junquera, S. and Zamarro, J. 1994. Sexual maturity and spawning of Greenland halibut (*Reinhardtius hippoglossoides*) from Flemish Pass area. Northwest Atl. Fish. Organ. Sci. Counc. Stud. 20: 47-52.

Description of the reproductive aspects of Greenland halibut (*Reinhardtius hippoglossoides*) in the Flemish Pass area in NAFO Div. 3L and 3M based on data from observers on board the Spanish commercial fishing fleet between May 1990 and Dec 1991 is presented. A maximum in the proportion of spawning females was found in summer with a secondary peak in Dec, while some spawning activity was observed throughout the rest of the year. The length at 50% maturity varied from 67.3 cm in 1990 (Div. 3L and 3M) to 73.2 cm in 1991 (Div. 3M). The influence of the reproductive behaviour on the evolution of catch rates is discussed.

Junquera, S., Iglesias, S., and de Cárdenas, E. 1992. Spanish fishery of Greenland halibut (*Reinhardtius hippoglossoides*) in 1990-91. NAFO SCR documents 92/28: 14 p.

The catches of Greenland halibut in Subarea 2 and Div. 3K and 3L increased in 1990 to about 47000 t (Brodie 1991) mostly due to the development of a deepwater fishery in the boundary of Div. 3L and 3M. The major participants in this fishery are Spain and Portugal and also some non-member countries such as Panama. The Spanish fleet is composed of bottom trawlers that fish at depths greater than 800 m. From the beginning of this fishery in (1990) until the early months of 1992, its skillfulness improved by adapting the fishing technology to work in deeper grounds. Finally it is managing to operate as deep as 1700 m in the first half of the present year. The gathering information about the fishing activity and the sampling the catches has been carried out by 8 observers in 1990 and 23 in 1991 that have been on board of the Spanish commercial ships. In this paper we present a first analysis of the information

Junquera, S., Rodriguez-Marin, E., and de Cárdenas, E. 1997. Spanish research report for 1996. NAFO SCS documents 97/10: 9 p.

Junquera, S., Sarasua, A., Rodriguez-Marin, E., de Cárdenas, E., and Motos, L. 1998. Spanish research report for 1997. NAFO SCS documents 98/11 (rev.): 12 p.

Junquera, S., Román, E., Paz, X., and Ramilo, G. 1998. Changes in Greenland halibut growth, condition and fecundity in the Northwest Atlantic (Flemish Pass, Flemish Cap and southern Grand Bank). NAFO SCR documents 98/95: 13 p.

The Greenland halibut (*Reinhardtius hippoglossoides*) fishable stock has been declining substantially since late-1980s, according to both surveys and commercial fishery indices, particularly among the ages 10+, which corresponds to the female age at 50% maturity. This paper reviews the apparent effect of this reduction in the stock abundance in two main groups of biological parameters, namely growth and reproductive parameters, since late-1980s. Among growth parameters, the analysis of the first year growth is undertaken both by cohort and by geographic areas, assuming that density dependence might be the most severe at younger age classes. This is done by using records of the respective first annual ring otolith diameters. Another growth related index such as the condition factor is also analysed. Two aspects of reproductive factors are considered: the interannual variations in length-at-maturity and in potential fecundity. A common feature observed is the relative stability of those characteristics through the period analysed, which could support a certain resiliency of the life history traits in this species.

Junquera, S., Murua, H., and de Cárdenas, E. 1999. An assessment for roughhead grenadier (*Macrourus berglax*) in NAFO Subareas 2 and 3. NAFO SCR documents 99/64: 19 p.

It has been recognized that the recent catches of grenadiers by EU-Portugal and EU-Spain in Subarea 3, previously reported to NAFO as roundnose grenadiers (*Coryphaenoides rupestris)*, correspond to roughhead grenadier (*Macrourus berglax*). Roughhead grenadier is taken as by-catch in the Greenland halibut (*Reinhardtius hippoglossoides*) fishery in the Regulatory Area mainly in Divisions 3LMN. Catches increased gradually and the largest proportion by country correspond to Spain and Portugal, with 6050 t. and 1089 t., respectively in 1998. A review of the biomass estimates from the available research surveys in Subareas 2 and 3 is presented. At present the higher part of the biomass is found in Div. 3L and 3N and at depths between 1000-1200 m. The age at full recruitment to the fishery is 8, and the total mortality (1997-1998) is Z=0.43. Female age at maturity is 15, corresponding to a PFL of 26.5 cm.

Junquera, S., Román, E., Paz, X., and Ramilo, G. 1999. Changes in Greenland halibut growth, condition and fecundity in the Northwest Atlantic (Flemish Pass, Flemish Cap and southern Grand Banks). J. Northwest Atl. Fish. Sci. 25: 17-28.

The Greenland halibut (*Reinhardtius hippoglossoides*) fishable stock has been declining substantially since the late 1980s, according to both surveys and commercial fishery indices, particularly among the ages 10+, which corresponds to the females age at 50% maturity. In this paper the effect of this apparent reduction in the stock abundance on growth and reproductive parameters is examined. Among growth parameters, the analysis of the first year growth is undertaken both by cohort and by geographic areas, assuming that density dependence might be the most severe at younger age classes. This is made using records of the respective first annual ring otolith diameters. Other growth related indices such as the condition factor is also analysed. Neither significant differences in the first year growth have been observed between areas analysed, nor

between cohorts, during the period 1988 to 1996. Mean condition factor-at-age from ages 1 to 13 were stable during this same period. Concerning reproductive parameters, two aspects are considered: the interannual variations in length-at-maturity and in potential fecundity. Female length at maturity varied between 64.5 and 69.5 cm. Female potential annual fecundity ranged between 15 000 and 158 000. It increases with female age, but the mean fecundity-at-age variations were not significant either between years of sampling or between cohorts. A common feature observed is the relative stability of those characteristics analysed throughout this period which could support a certain resiliency of the life history traits in this species.

Junquera, S., de Cárdenas, E., Vazquez, A., and Murua, H. 1999. Spanish research report for 1998. NAFO SCS documents 99/6: 11 p.

Junquera, S., Vazquez, A., and Cardenas, E. 2000. Greenland halibut depth variations of catch-per-unit effort, length composition, mature proportions and associated by-catches in Divisions 3LMNO. NAFO SCR documents 00/67: 13 p.

This paper presents a review of the geographic and bathimetric patterns of occurrence of the Greenland halibut (*Reinhardtius hippoglossoides*) catches in NAFO Divisions 3LMNO and their incidence on the catch of other stocks, namely cod (*Gadus morhua*), American plaice (*Hippoglossoides platessoides*), and yellowtail (*Pleuronectes ferruginea*), and witch flounders (*Glyptocephalus cynoglossus*). The Greenland halibut mature proportions at depth in both the commercial catches and the spring Spanish 3NO survey indices are also presented. According to the results of the Spanish fleet, the Greenland halibut fishery does not overlap significantly with American plaice, yellowtail flounder, skate or cod. By-catches of witch flounder in the Greenland halibut fishery have been very small, at least in 1999. The CPUE analysis indicate that Greenland halibut is best caught in the deepest strata, with catch rates comparatively poor at depths less than 600 m. A sharp change in catchability is observed between 500 - 600 m. The proportion of mature fish in the catches increases with depth attaining a maximum between 1200 - 1600 m. The survey results indicate that most of the SSB is found at depths beyond 800 m.

Junquera, S., Vazquez, A., Murua, H., Román, E., and del Rio, J.L. 2000. Spanish research report for 1999. NAFO SCS documents 00/20: 14 p.

Junquera, S., Román, E., Morgan, J., Sainza, M., and Ramilo, G. 2001. Time scale of ovarian maturation in Greenland halibut. NAFO SCR documents 01/124: 11 p.

In this paper possible evidence of a prolonged ovarian development phase in Greenland halibut (*Reinhardtius hippoglossoides*) is presented. The reproductive cycle in this species has been originally described based on the assumption that this phase should last about one year. The results of several years of analysis showed that there is more than one year between the mean age of females at the onset of ovarian development and the mean age of actually spawning females. Two possible interpretations of this fact are discussed: the ovarian development phase (vitellogenesis) could last more than one year, and individual spawning does not necessarily occur on an annual basis as a consequence, or the incidence of non-spawning females every year could be very high. Both possibilities have important implications for the species' reproductive potential and stock dynamics of this valuable deep water resource.

Junquera, S., Vazquez, A., Murua, H., del Rio, J.L., Román, E., and Gonzalez, F. 2001. Spanish research report for 2000. NAFO SCS documents 01/18: 24 p.

Junquera, S., Román, E., Morgan, J., Sainza, M., and Ramilo, G. 2003. Time scale of ovarian maturation in Greenland halibut (*Reinhardtius hippoglossoides*, Walbaum). ICES J. Mar. Sci. 60: 767-773.

Evidence for a prolonged ovarian development phase in Greenland halibut is presented. The reproductive cycle in this species was originally described based on the assumption that this phase should last about one year. The results of the present study, which involves data series covering a long time period and different geographic areas, show instead that there is more than one year between the mean age of the females that are at the onset of ovarian development and the mean age of the females that are actually spawning. There are two possible interpretations for this observation. One is that the ovarian development phase (vitellogenesis) could last more than one year and thus as a consequence, individual spawning would not necessarily occur on an annual basis. The other would be the existence of a high proportion of non-spawning females every year for other reasons not related with the natural rhythm of oocyte development.

Jurado-Molina, J. and Livingston, P. 2002. Climate-forcing effects on trophically linked groundfish populations: implications for fisheries management. Can. J. Fish. Aquat. Sci. 59: 1941-1951.

Commercially important groundfish populations in the Bering Sea are connected through the food web as predators and prey. In addition to having different trophic roles, the recruitment of these species varies on interdecadal time scales and may be related to climate forcing. The effects of fishing mortality on eight trophically linked species under two scenarios of climate regimes using the multispecies virtual population analysis (MSVPA) model and the multispecies forecasting model (MSFOR) is simulated. Species respond differently to climate change assumptions and fishing mortality depending on their position in the food web. Results suggest that the assumptions regarding climate regime shifts on mean recruitment may produce effects comparable to the ones produced by fishing and predation interactions. Therefore, accurate models for fisheries management would require considering these factors and their potential interactions. Because responses are complex and difficult to predict, it is necessary to take a risk-averse approach in managing the species with the largest potential variation. The incorporation of climate regime shifts in fisheries management will require a better understanding of recruitment during a particular regime and a reliable way to identify regime shifts based on biological and (or) physical indices.

Jurado-Molina, J. and Livingston, P. 2002. Multispecies perspectives on the Bering Sea groundfish fisheries management regime. N. Am. J. Fish. Manage. 22: 1164-1175.

The need to understand the multispecies implications of various harvesting regimes is becoming more important as fishery managers move toward ecosystem-based management. We explore the possible effects that different exploitation rates may have on eastern Bering Sea groundfish using a multispecies simulation context that incorporates predator-prey relationships. At present, some groundfish species in the eastern Bering Sea are exploited up to the recommended levels of allowable biological catch, whereas others, for economic or bycatch limitation reasons, are only lightly exploited. We explore the possible long-term multispecies implications of different exploitation patterns on the biomass and yield of several groundfish species using predator-prey suitability estimates derived from multispecies virtual population analysis (MSVPA) in a multispecies simulation modeling context and compare those predictions with those from single-species forecasting models. Three different fishing scenarios that included eight species in the eastern Bering Sea were implemented in these models. In one scenario, the present exploitation rates were used for the model simulations; in the second scenario, all exploited species were more evenly exploited by fishing each species at its recommended allowable biological catch levels; and in the third scenario, there was no fishing for all the species. Results from the single-species and multispecies model simulations mostly showed the same direction of population trends. However, the magnitude of change was different for some species, which can be ascribed mainly to predation interactions. Greater differences were seen between the simulations that used the present exploitation rates and those in which no fishing occurred. The multispecies simulations that included predation interactions predicted much lower equilibrium population sizes for prey species populations under conditions of no fishing than did single-species simulations that did not take predator-prey relationships into account. These results show that multispecies models provide new insights into the implications of single-species harvesting strategies, particularly for prey species that are also the target of commercial fisheries.

Jurado-Molina, J., Livingston, P., and Gallucci, V.F. 2005. Testing the stability of the suitability coefficients from an eastern Bering Sea multispecies virtual population analysis. ICES J. Mar. Sci. 62: 915-924.

Suitability coefficients are important for the estimation of predation mortality in a multispecies virtual population analysis (MSVPA) and subsequent use in the multispecies forecasting model (MSFOR). Testing the assumption of the stability of the suitability coefficients is important in assessing the robustness of the predictions made with MSFOR. We used different statistical methods to partially test this assumption for the eastern Bering Sea MSVPA model with eight species, using stomach content data for the years 1985-1989. Comparison of the estimates from two different sets of stomach content data (set one with all data and set two mainly with data from 1985) suggested that the differences between the two types of estimates were much reduced when the number of predator stomachs sampled increased. In a second approach, we contrasted the residual variances of partial data sets with the results from the fit of the total data set. Results suggested a small increase (similar to 10.8%) in the variation of the suitability coefficients. Comparison of the means of the suitability coefficients associated with each predator species suggests that only 13 of the 50 possible pairwise contrasts were significantly different (alpha = 0.05). In general, results suggested. that the predator preferences and prey vulnerabilities remained stable over the time period studied. Therefore, MSFOR could be considered as a toot to advise fisheries managers within a multispecies context.

Kamra, S. K. 1967. A report to the fishing industry on the problem of discolored flesh in gill-net turbot (Greenland halibut). New series circular (Fisheries Research Board of Canada. Halifax Laboratory) 30, 3 p.

This report describes the discolouration in Greenland halibut (turbot) landed in Newfoundland. Describes the discolouration arising from fish handling practices and constriction of fish in gill nets. Suggests remedies for discolouration and their impact on the catch.

Kanneworff, P. and Pedersen, S.A. 1991. Survey biomass of Greenland halibut (*Reinhardtius hippoglossoides*) off West Greenland (NAFO Subareas 0+1), July - August 1988, 1989 and 1990. NAFO SCR documents 91/45: 12 p.

A yearly stratified-random shrimp trawl survey in the main distribution area for shrimp (*Pandalus borealis)* off West Greenland was initiated in July 1988 by Greenland Fisheries Research Institute (Carlsson and Kanneworff 1991). This paper presents estimates of biomass, abundance and size distributions for Greenland halibut based on by-catch data collected during the shrimp trawl survey in July 1988, July-August 1989 and July- August 1990.

Kanneworff, P. and Pedersen, S.A. 1992. Survey biomass of Greenland halibut (*Reinhardtius hippoglossoides)* off West Greenland (NAFO Subareas 0+1), July-August 1988-91. NAFO SCR documents 92/45: 11 p.

A yearly stratified-random shrimp trawl survey in the main distribution area for shrimp

(*Pandalus borealis*) off West Greenland was initiated in July 1988 by Greenland Fisheries Research Institute (Carlsson and Kanneworff 1991). This paper presents estimates of biomass, abundances and size distributions of Greenland halibut based on by-catch data collected during the shrimp trawl survey in July-August 1988-91.

Karamushko, O. V., Yunacheva, O. Y., Berestovsky, E. G., and Karamushko, L. I. 2002. Nekotorye rezul'taty issledovanij ryb v rajone arkhipelaga Shpitsbergen v 1999-2001 [Some results of fish investigations in the area of the Spitsbergen Archipelago in 1999-2000]. *In* Kompleksnye issledovaniya prirody Shpitsbergena [The complex investigations of the Spitsbergen nature]. *Edited by* Matishov, G. G. and Tarasov, G. A. Murmansk Marine Biological Insitute (MMBI), Murmansk (Russia). pp. 158-166.
[In Russian, English summary]

Some questions of fishes' biology inhabiting in the area on the Bear Island -- Spitsbergen are discussed. During the investigation period in 1999-2000 20 species and sub-species are revealed in the catches. Dynamics of distribution density of commercial fish species, their length characteristics, feeding, maturation near the Spitsbergen Archipelago have spatial-temporal variations connected with the rhythms of ecosystems functioning in general, and in the fish part of community in particular. The biology and distribution are considered for the following species: *Macrourus berglax, Gadus morhua, Melanogrammus aeglefinus, Pollachius virens, Brosme brosme, Sebastes marinus, Sebastes mentella, Cyclopterus lumpus, Anarhichas denticulatus, Anarhichas lupus, Anarhichas minor, Hippoglossoides platessoides, Pleuronectes platessa, Reinhardtius hippoglossoides* as well as for the species of the families Cottidae and Rajidae.

Karl, H. 2000. Einfluss der Verarbeitung auf lipophile chlororganische Rueckstaende in Fischen [Influence of processing on lipophilic organochlorine residues in fish]. Inf. Fischwirtsch. Fischereiforsch 47: 52-57.
[In German, English summary]

Influence of fish processing methods on changes of chlordane and toxaphene residue concentrations were studied in various fishery products. Investigation included smoking, marinating and canning of fish. Smoking of Greenland halibut (*Reinhardtius hippoglossoides*) and ocean perch (*Sebastes marinus*) led to an increase in chlordane and toxaphene residue amounts in the edible part in relation to the raw material. A similar increase was observed during the marinating process of herring (*Clupea harengus*) fillets. In both cases, loss of water was responsible for the observed changes in residue contents. The fat and thus the lipophilic organochlorine compounds remained completely in the products. Canning of herring fillets in tomato sauce reduced the residue concentration of the final product due to dilution by the tomato sauce. The concentrations in the fillets kept nearly unchanged even after storage of cans for six months. No equilibration was observed between residue concentrations in fillets and sauce.

Karl, H., Khandker, S., and Alder, L. 1999. Variation of toxaphene indicator compounds in fish from single fishing grounds: conclusions for sampling. Chemosphere 39: 2497-2506.

The levels of three toxaphene indicator compounds were determined in individual lots of herring, redfish, Greenland halibut and farmed salmon. Concentration levels of the three marine fish species were characterised by a right-skewed frequency distribution whereas residue concentrations in farmed salmon were normally distributed. The toxaphene concentrations in the edible part of redfish, herring and Greenland halibut were found to be positively correlated to the sizes and thus to age. As results show, for representative sampling of a landed catch, not more than 10 individual fishes from typical size classes of a lot are necessary for a pooled sample.

Karl, H., Ruoff, U., and Blüthgen, A. 2002. Levels of dioxins in fish and fishery products on the German market. Chemosphere 49 : 765-773.

In 1995-98, the contents of polychlorinated dibenzodioxins and dibenzofurans of 184 pooled fish samples were analysed. Sampling focused on fish and fishery products with a market share of more than 1% and covered all fishing grounds important for the supply of the German market. Investigation included 15 different fish species (*Theragra chalcogramma, Anarhichas, Gadus morhua, Reinhardtius hippoglossoides, Melanogrammus aeglefinus, Merluccius, Hippoglossus hippoglossus, Clupea harengus, Scomber scombrus, Pleuronectes platessa, Sebastes, Salmo salar, Sardina pilchardus, Pollachius virens* and *Oncorhynchus mykiss*), shrimp, mussel and squid samples and various fishery products, typically on the German market. Generally lean fish species like cod, saithe or Alaska pollock were less contaminated on fresh weight basis than fat fish species like herring, Greenland halibut and sardine. In herring the dioxin content is related to the fishing ground. Low concentrations were found in North Sea herring, high concentrations measured in samples from the Baltic Sea. Dioxin contents in fishery products did not differ significantly from the raw fish samples. Results allow an estimation of the daily intake of dioxins and furans via fish consumption in Germany. Based on a daily fish consumption of 20 g the average intake of dioxins via fish is 6.2 pg WHO-PCDD/F-TEQs per person and day.

Karnicka, B. and Jurewicz, I. 1974. Changes in the content of trymethylamine oxide, trimethylamine and totalvolatile basic nitrogen in fresh and frozen fish. Can. Transl. Fish. Aquat. Sci. 2928: 14 p.
[Translated from Polish: Zmiany zawartosci tlenku trojmetyloaminy, trojmetyloaminy ilotnych zased amonowych w rybach swiezych i mrozonych. Original appeared in: Pr Morsk Inst.Ryback., 16B, 193-203, 1971]

To investigate the usefulness of TMAO, TMA and TVB tests for estimation of fish quality, determinations were made of the contents of these compds in the most of frozen fish spp from the fishing grounds of Northwest Atlantic (*Gadus morhua, Sebastes marinus, Reinhardius hippoglossoides, Pleuronectes cynoglossus. Drepanopsetta platessoides*) stored at a temp of -25{degree}C and in the meat of fresh fish from the Baltic Sea (*Platichthys flesus, Gadus morhua*) stored in ice. In frozen fish, as opposed to fresh ones, no distinct changes in the contents of above chemical compounds were found.

Karpouzli, E. and Leaper, R. 2004. Opportunistic observations of interactions between sperm whales and deep-water trawlers based on sightings from fisheries observers in the northwest Atlantic. Aquat. Conserv.: Mar. Freshwat. Ecosyst. 14: 95-103.

Cetacean observations were made by fisheries observers on trawlers targeting Greenland halibut (*Reinhardtius hippoglossoides*) in the area around the Flemish Cap, northwest Atlantic. Data from four observers amounted to a total of 291 observer days at sea aboard fishing vessels. This effort was mainly concentrated in the periods July to September 1996 and February to April 1997. Sperm whales (*Physeter macrocephalus*) were the most frequently sighted cetacean, with 82 encounters on 64 different days. Pilot whales were encountered on nine occasions. Sighting rates of sperm whales during net hauling were significantly (approximately 30 times) greater than during shooting or steaming. Sperm whales were observed in aggregations of up to six animals close to the vessel and net during hauling. It is suggested that the sperm whales were attracted by the potential food source within the net, and possibly were feeding on fish escaping from the net. This represents rarely reported behaviour for this species.

Kawahara, S. 1985. Japanese research report for 1984. NAFO SCS documents 85/13: 3 p.

Kawahara, S. 1986. Japanese research report for 1985. NAFO SCS documents 86/14: 4 p.

Kawahara, S. 1987. Japanese research report for 1986. NAFO SCS documents 89/13: 4 p.

Kawahara, S. 1988. Japanese research report for 1987. NAFO SCS documents 88/13: 4 p.

Kennedy,V.S. 1976. Arsenic concentrations in some coexisting marine organisms from Newfoundland and Labrador. J. Fish. Res. Board Can. 33: 1388-1393.

Inorganic arsenic concentrations in sea water and mud, and total arsenic concentrations in bodies of shrimp, zooplankton, and fish from northern Newfoundland and southern Labrador were measured. There was a positive relationship between concentration and carapace length in *Pandulus borealis* and *P. montagui* and a negative relationship in *Eualus macilentus*. There was no relationship between concentrations in shrimp eggs and carpace length. Arsenic concentrations in zooplankton and fish muscle were relatively low compared with the shrimp sp; amphipods contained more arsenic than copepods or euphausiids, and American plaice (*Hippoglossoides platessoides*) more than redfish (*Sebastes marinus)*, turbot (*Reinhardtius hippoglossoides*), and Atlantic cod (*Gadus morhua).* There was no evidence of increasing arsenic concns through successively higher levels of the food chain.

Khan, R.A., Dawe, M., Bowering, R., and Misra, R.K. 1981. Blood protozoa as an aid for separating stocks of Greenland halibut (*Reinhardtius hippoglossoides* (Walbaum)) in the northwestern Atlantic. ICES CM 1981/G:40: 14 p.

Khan, R.A., Dawe, M., Bowering, R., and Misra, R.K. 1982. Blood protozoa as an aid for separating stocks of Greenland halibut, *Reinhardtius hippoglossoides* in the northwestern Atlantic. Can. J. Fish. Aquat. Sci. 39: 1317-1322.

Samples of subadult Greenland halibut, *R. hippoglossoides*, from several northwest Atlantic locations, the Gulf of St. Lawrence, and Fortune Bay, an inlet on the south coast of Newfoundland, were examined for the prevalence of two blood protozoa. Because prevalence of infection varied widely, the data were analyzed using the general least squares analysis of fitting constants on logit values. Trypanosome and piroplasm infections in samples from Davis Strait, NAFO divisions 2G-2H and div. 3L, were mostly similar, but differed significantly from div. 2J-3K. Trypanosome infections in samples from the northwest Atlantic locations were significantly higher than in the Gulf of St. Lawrence and Fortune Bay. Piroplasm infections were significantly higher in samples from Fortune Bay than in the Gulf of St. Lawrence. The results suggest that Greenland halibut from Davis Strait, div. 2G-2H and div. 3L, are composed of one stock complex, while fish from div. 2J-3K represent an isolated group or most probably a cline between areas. Greenland halibut from the Gulf of St. Lawrence and Fortune Bay appear to represent distinct stocks.

Khan, R.A., Lee, E.M., and Whitty, W.S. 1991. Blood protozoans of fish from the Davis Strait in the northwestern Atlantic Ocean. Can. J. Zool. 69: 410-413.

Parasites were seen in all 17 species of fish examined; piroplasms were most prevalent (78% of 413), infecting all fish species. Prevalences of infection were substantially lower for trypanosomes (23%) and haemogregarines (4%), both of which infected only 10 and 6 of the fish species, respectively. Prevalences were greatest in *Reinhardtius hippoglossoides, Hippoglossoides platessoides, Lycodes lavalaei, Macrourus berglax* and *Raja radiata.* It is likely that fish haematozoans and their leech vectors originated in the northern latitudes and radiated southwards.

Kihara, K. 1976. Studies of the formation of demersal fishing ground. 3. Recurrent group analysis of demersal fish in the Eastern Bering Sea. Umi/Mer 14: 11-22.

The recurrent groups of demersal fish in the E Bering Sea were analyzed with data from bottom trawl fishing investigations. On the continental shelf, Limanda aspera, Theragra chalcogramma, Lepidopsetta bilineata, Gadus macrocephalus and Cottidae showed significant affinities for each other and were leading species which constituted main recurrent groups every year. *Eleginus gracilis, Osmerus eperlanus mordax, Liparidae, Reinhardtius hippoglossoides* and shrimp showed few significant affinities with other species. At the depths of 150, 200, 300 and 400 m on the continental slope, *Atheresthes stomias, Cottidae, T. chalcogramma* and *Hippoglossoides elassodon* showed significant affinities for each other and were leading species which constituted main recurrent groups at each depth in the summer.

Kihara, K. 1990. Distributions of recurrent groups and predators of walleye pollock *Theragra chalcogramma.* J. Tokyo Univ. Fish. 77: 263-273.

Distributions of recurrent groups and major predators of walleye pollock were demonstrated in the eastern Bering Sea during summers from 1979 to 1984. Small pollock (both sexes: <20 cm) inhabited 100-200 m depths from St. Matthew Island to the Pribilof Islands from 1980 to 1984, and was found near the central shelf in 1983 and 1984. Inhabited area of large walleye pollock was over the outer shelf and slope in order to avoid colder water temperatures. Greenland turbot was found with many other species in the east region of St. Matthew Island every year. Arrowtooth flounder and yellow Irish lord were found with other species in the same region along shelf edge in the south of Pribilof Islands every year. Thorny sculpin occurred in the west of St. Matthew Island during summers from 1979 to 1984 except 1982. Habitats of spinyhead sculpin and bigmouth sculpin adjoined to the area of smaller pollock in the south of St. Matthew Island.

Kim, S.T. and Biryukov, I.A. 1998. Distribution and some biological aspects of the black halibut *Reinhardtius hippoglossoides matsuurae* (Pleuronectidae) and the sculpin *Sebastolobus macrochir* (Scorpaeniade) of Sakhalin east coast. Vopr. Ikhtiol. 38: 151-154. [In Russian]

Kimura, D.K. and Chikuni, S. 1987. Mixtures of empirical distributions: an iterative application of the age-length key. Biometrics 43: 23-36.

It is well known that an age-length key is capable of providing biased estimates of age distributions, when length distributions are applied to age-length keys constructed from sampling in a different year from that in which the length data wre collected. In separate unpublished papers, Fukuda and Chikuni (Far Seas Fisheries Research Laboratory, Fisheries Agency of Japan, 1974) proposed a method of interating an age-length key that corrects this problem. For a length distribution collected in any year, their method provides an estimate of the age distribution corresponding to this length distribution, which is consistent with an age-length key constructed from the estimated age distribution and previously estimated length-at-age distributions. We show that this method is an application of the EM algorithm to mixtures of empirical distributions. Also, we give conditions for which these estimates of age distribution are unique, maximum likelihood estimates. The method is used to estimate age distributions of the catch of Greenland turbot, *Reinhardtius hippoglossoides*, by small Japanese freezer trawlers in the eastern Bering Sea.

Kingsley, M.C.S. and Carlsson, D.M. 1998. An experimental investigation on spatial and depth variation in catch of shrimp, Greenland halibut and redfish. NAFO SCR documents 99/119: 6 p.

An experimental bottom-trawl survey for northern shrimp (*Pandalus borealis)* was carried out in early August 1997 to examine small-scale spatial structure of shrimp population densities. Catches of northern shrimp, Greenland halibut (*Reinhardtius hippoglossoides*) and redfish (*Sebastes* spp.) were weighed and sampled for investigation of size compositions. The catch data was deskewed with an nth-root transform. Between-days variation was measured with correlation coefficients, and the spatial structure of the resource with serial correlation coefficients along transects. Day-to-day variation was small, and there was good correlation between days for all species, both overall and within transects. There was an unexpected, and quite striking lack of serial correlation in catches along isobathic transects for all species, as though the resource was distributed by a random process. Along the variable-depth transects, there were higher serial correlations, and overall statistical significance, as though there was a depth response. Most of this was due to clear depth response in the catches of Greenland halibut, which increased steadily with increasing depth. In the shrimp catches alone, there was little evidence of serial correlation or spatial structure.

Kodolov, L. S. and Matveychuk, S. P. 1995. Stock condition of Greenland turbot (*Reinhardtius hippoglossoides matsuurae* Jordan et Snyder) in the northwestern Bering Sea. *In* Proceedings of the International Symposium on North Pacific Flatfish, October 26-28, 1994, Anchorage Alaska. Alaska Sea Grant Colllege Program report; AK-SG-95-04; Lowell Wakefield fisheries symposia series; 12. 1995. pp. 451-465.

Pacific turbot is abundant in both the Okhotsk and Bering seas close to the Kuril and Aleutian islands, and forms a single population in the Bering Sea. Juveniles of the 0+ to 2+ age groups are distributed in the northeastern Bering Sea shelf in Anadyr Bay and the adjacent American zone, and then settle along the eastern Bering Sea shelf. Immatures aged 3-6 migrate to the northern part of the continental slope, including the Russian waters in the northwest. This is determined by the relative abundance of juveniles aged 2+ to 7+ in this area. In the 1980s the Bering Sea stock was very depressed, probably due to both the natural decrease in abundance and the uncontrolled bycatch of juveniles in fisheries for other species. Currently there are indications of population rebuilding.

Kodolov, L.S. and Savin, A.B. 1997. Setnoj promysel chernogo paltusa v Okhotskom more [Greenland halibut net fishery in the Sea of Okhotsk]. Rybn.Khoz. 4: 40-42. [In Russian]

Greenland halibut (*Reinhardtius hippoglossoides*) is fished with bottom trawls at western Kamchatka in the Okhotsk Sea and in the northwestern Bering Sea. In other areas of the Russian zone bottom trawling fishery is impracticable because of the rugged bottom or the absence of sufficiently dense fish concentrations. The paper describes experimental fishing with bottom gillnets from small seiners in continental slope areas of the Okhotsk Sea with rough bottoms. Data on the catch composition, catch/effort and size composition of Greenland halibut in gillnet catches are presented. The data suggest sufficient efficiency of gillnets used to fish for Greenland halibut in areas with rough bottoms.

Koester, F.W. 1986. Analyse ausgewaehlter probleme bei der berechnung von gleichgewichtsertraegen fur Seefischbestaende [Analysis of selected problems in calculating yield per recruit curves for marine fish stocks]. Bundesforschungsanstalt fur Fischerei (Germany). Institut fur Seefischerei. Hamburg, Germany. Mitteilungen; 39: 151 p.

Koester, F.W. 1986. Analysis of selected problems in calculating yield per recruit curves for marine fish stocks. ICES CM 1986/G:64.

This paper examines the sensitivity of yield per recruit calculations on possible errors in selected input values. In order to estimate the magnitude of deviations caused by such errors, the input values are varied within ecological reasonable limits. The calculations were performed for four species of different biological characteristics for comparison.

Further the paper discusses the reliability of estimates of potential yields and corresponding stock sizes obtained when incorporating a stock recruitment relationship according to Shepherd (1982). The analysis also considers whether new reference points suggested by the Working Group on Methods of Fish Stock Assessments (1983+84) are suitable as indicators for the probability of recruitment failures. The results derived in the test calculations indicate a high sensitivity for erroneous values of natural mortalities in both cases.

Koie, M. 1993. Nematode parasites in teleosts from 0 to 1540 m depth off the Faroe Islands (The North Atlantic). Ophelia 38: 217-243.

In the present study 416 specimens belonging to 43 species of teleost fishes from shallow waters down to a depth of 1540 m off the Faroes were examined for nematode parasites. All in all, about 20 nematode species were found. Most nematodes are new to the area and many represent new host records. *Capillaria gracilis* was found in gadoids including *Molva molva*. Third-stage larvae of *Anisakis simplex* (sensu lato) were found down to a depth of 1540 m. One larva of *Anisakis physeteris* was found in *Epigonus telescopus*. Third-stage larvae of *Pseudoterranova decipiens* (s.l.) were found in the liver of *Lophius piscatorius* and *Reinhardtius hippoglossoides*, whereas they occurred in the musculature of *Myoxocephalus scorpius* and *Hippoglossoides platessoides* and in the musculature and between the caeca of gadoids. Small encapsulated third-stage larvae (1.5-3.5 mm long) of Contracaecum sp. are regarded as avian species, whereas large third-stage larvae (0.5-2.0 cm long) on the fish viscera are believed to be *C. osculatum* (s.l.). Larvae and adults of *Hysterothylacium aduncum* (s.l.) were found in most fish species down to a depth of 1030 m. *Hysterothylacium rigidum* were common in the stomach of *L. piscatorius*, the previously unknown third-stage larvae were found encapsulated in the intestinal wall of gadoids and pleuronectids. The previously unknown male of *Ichthyofilaria bergensis* (Wulker, 1930) n. comb. was found together with females in *Molva dipterygia. Spinitectus oviflagellis* was found in *Molva* spp., *Sebastes viviparus* and *Lepidion eques*. Larvae of *Spinitecioides berlandi* occurred in *Trisopterus minutus. Ascarophis morrhuae* and *A. crassicollis* were found in gadoids and an apparently undescribed species of *Ascarophis* occurred in *Lycodes* spp. and liparid fishes down to a depth of 1540 m. *A. arctica* was found in the gadoid *Ciliata mustela* only.

Koie, M. 2000. Metazoan parasites of teleost fishes from Atlantic waters off the Faroe Islands. Ophelia 52: 25-44.

532 specimens belonging to 50 species of teleost fishes collected from shallow waters down to a depth of 1,540 m off the Faroes were examined for metazoan parasites. Ten or more specimens of the following fish species were examined: *Argentina silus, Gasterosteus aculeatus, Gadus morhua, Melanogrammus aeglefinus, Merlangius merlangus, Micromesistius poutassou, Pollachius virens, Trisopterus esmarki, Molva dipterygia, Onogadus argentatus, Lycodes esmarki, L. pallidus, Sebastes mentella, S. viviparus, Myoxocephalus scorpius, Artediellus atlanticus, Cottunculus sadko, Paraliparis bathybius, Rhodichthys regina, Hippoglossoides platessoides, Limanda limanda, Microstomus kitt* and *Reinhardtius hippoglossoides*. The nematodes were dealt with in a previous paper. In the present study 38 species of digeneans, with review of their life-cycles, are recorded. In addition, 8 species of monogeneans, 11 species of copepods, and 2 species of leeches, among other a 19 cm long specimen of Notostomum laeve, are recorded. Most acanthocephalans are identified to genera and most cestodes are identified to order only. Most species are new to the Faroes.

Konstantinov, K.G. and Noskov, A.S. 1971. USSR research report, 1970. ICNAF Res. Doc. 71/53: 32 p.

Konstantinov, K.G. and Noskov, A.S. 1976. USSR research report, 1975. ICNAF Res. Doc. 76/VI/20: 33 p.

Konstantinov, K.G. and Noskov, A.S. 1980. USSR research report for 1979. NAFO SCS documents 80/VI/18: 33 p.

Konstantinov, K.G., Chumakov, A.K., Nikeshin, K.N., and Kovalenko, V.G. 1982. On validity of trawl mesh size used in fishing areas of the Northwest Atlantic. NAFO SCR documents 82/14: 30 p.

The validity of mesh size in trawl bags in relation to redfish (*Sebastes mentella*), Greenland halibut (*Reinhardtius hippoglossoides*), roundnose grenadier (*Macrourus rupertris*), yellowtail flounder (*Limanda ferruginea)*, American plaice (*Hippoglossoides platessoides)* is proved on the basis of selectivity estimation.

Kosior, A. 1975. Polish investigations on Greenland halibut in the Northeast Arctic in 1973. Ann. Biol. (Cph.) 30: 172-173.

Polish catches of Greenland halibut (*Reinhardtius hippoglossides*) in northeast Arctic grounds (ICES Decisions IIa and IIb) decreased to 2140 t in 1973. Data on length and sex composition, gonad maturity and wt of the fish are presented. Fish from the western slopes of the Bear Island grounds were larger than those from areas west of Spitshbergen.

Kosswig, K. 1980. Fischereibiologische Untersuchungen vor Ost- und Westgroenland (40. Reise des FFS Walther Herwig , 9.6.-24.7.1980) [Fishery-biological investigations off east- and west Greenland (40. cruise of FRV Walther Herwig , 9.6.-24.7.1980)]. Inf. Fischwirtsch. 27: 171-179.
[In German, English summary]

In June/July the first of several projected cruises for 1980 was made to investigate the fishing resources of east- and west Greenland and to get information on the biology of commercially important demersal fish, especially *Sebastes marinus, Reinhardtius hippoglossoides*, and *Gadus morhua*. The length distribution in correlation to the horizontal distribution and the catch/effort are reported.

Kosswig, K. 1981. Fischereibiologische Untersuchungen vor Ostgroenland und auf der Dohrn Bank (45. Reise, II. Teil des FFS Walther Herwig vom 23.6.-23.7.1981) [Stock Assessment in the Coastal Waters of East Greenland (Dohrn Bank)]. Inf. Fischwirtsch. 28: 159-163.
[In German]

On the second part of the 45th cruise of the FFS Walter Herwig stock assessment on the cod (*Gadus morhua*) and the redfish (*Sebastes marinus*) has been carried out in the ICES Subarea XIV from 23.6. - 23.7.1981. Blue whiting (*Micromesistius poutassou*), rat-tail (*Coryphaenoides rupestris*) and Greenland halibut (*Reinhardtius hippoglossoides*) have furthermore been of special interest and were assessed.

Kovaleva, A.A., Zubchenko, A.V., and Krasin, V.K. 1983. Foundation of a new myxosporidean family (Protozoa, Myxosporidia) with a description of two new genera. Parazitologiia 17: 195-202.
[In Russian, English summary]

Kovtsova, M.V. and Nizovtsev, G.P. 1985. Peculiarities of growth and maturation fo Greenland halibut of the Norwegian-Barents Sea stock in 1971-1984. ICES CM 1985/G:7: 17 p.

Peculiarities of growth and maturation of Greenland halibut in the 70-80ies are considered in the paper. Fish maturation of different length and age is analyzed. The rate of present-day maturation and also a structure of the spawning stock are elucidated. The spawning stock in estimated.

Kroeger, M. and Schubring, R. 2001. Recognition of fish species by surface pattern classification of skinned fillets. Dtsch. Lebensm. Rundsch. 97: 216-221.

Fish quality changes are usually connected with changing of appearance and texture. The assessment of appearance is a part of sensor evaluation, carried out by experts providing objective but inexact data. Up to now there is no instrumental sensor supplying data which correlate to the experts assessment data for appearance. Instrumental colour measurement mirrors only a part of appearance. The objective of the method presented here is to fit the experts inexact but wide knowledge with the data from cameras. A test for the suitability of the method is the classification of fish species from skinned fish fillets by a computer aided interpretation of surface patterns.

Krzykawski, S. 1975. Age and growth rate of the Greenland halibut *Reinhardtius hippoglossoides* Walbaum from the northern Atlantic. ICES CM 1975/F:24: 15 p.

Krzykawski, S. 1976. A comparative analysis of some anatomical elements with regard to their relevance to the age and growth rate determination in Greenland halibut, *Reinhardtius hippoglossoides* (Walbaum). Acta Ichthyol. Pisc. 6: 63-78.

The present paper evaluates the applicability of various anatomical parts of fish to age determinations and growth rate calculations. Additionally, the results of attempts to improve the conspicuousness of seasonal zones by calcinations and staining are presented.

Krzykawski, S. 1976. A characteristic of growth of Greenland halibut, *Reinhardtius hippoglossoides* (Walbaum), from the North Atlantic. Acta Ichthyol. Pisc. 6: 79-102.

Results of studies on length distribution, length and weight growth rates, and length-weight relationship in Greenland halibut are presented. The populations concerned are those inhabiting the Newfoundland ICNAF fishing grounds as well as those in the ICES areas of the Barents Sea and Icelandic waters.

Krzykawski, S. 1991. Morphometry and growth of Greenland halibut *Reinhardtius hippoglossoides* (Walbaum, 1792) off Labrador. Acta Ichthyol. Pisc. 21: 87-105.

The paper presents the morphometric characteristics as well as results of study on length and age distributions, length and weight growth rates and length-weight relationships of the Greenland halibut population inhabiting the region off Labrador.

Krzykawski, S. 1992. Biometric characters and growth of Greenland halibut *Reinhardtius hippoglossoides* (Walbaum, 1792) from the Barents Sea. Acta Ichthyol. Pisc. 22: 97-111.

The paper describes meristic and metric characters of the Barents Sea population of *Reinhardtius hippoglossoides*. Additionally, the length and age distributions, as well as the rate of length growth and length-weight relationship were estimated.

Krzykawski, S. and Wierzbicka, J. 1992. An attempt to determine systematic position of Greenland halibut, *Reinhardtius hippoglossoides* (Walbaum, 1792), from Labrador region and Barents Sea on the basis of morphometric, biologic, and parasitological studies. Acta Ichthyol. Pisc. 22: 59-75.

The paper present comparative results on the variability of measurable and countable parameters, growth rate, length and weight as well as on the parasitologic studies of Greenland halibut (*Reinhardtius hippoglossoides*) from the region of Labrador and from the Barents Sea.

Kuhlmann, H., Muenkner, W., and Oehlenschlaeger, J. 2001. Sensibilitaet von Seefischen an Bord. Teil 3: Untersuchungen an demersalen Fischarten der Barentssee [Sensitiveness of sea fishes on board. Part 3: Investigations on demersal fish species of the Barents Sea]. Inf. Fischwirtsch. Fischereiforsch 48: 34-37.
[In German, English summary]

In previous papers the sensibility of pelagic and demersal fishes caught at depth of up to 80 m was reported. This paper deals with the sensitiveness of flatfishes, gadids, and redfish caught at depth between 260 and 450 m and with trawling times between 1 and 6 h. The sensitiveness of the fishes was tested according to the method described in previous publications (Muenkner et. al. 1998) after 10 min keeping in running sea water and after 1 h bulk storage respectively. The sensitiveness of the fishes increased from cod to saithe to haddock. Surprisingly American plaice and Greenland halibut turned out to be very sensitive, far more sensitive than plaice and dab caught at lower depths in the North Sea. This was indicated by the high amount of animals showing rigor already after a trawling time of 2 h and 10 min of keeping in seawater. After 1 h of bulk storage and increasing trawling time sensitiveness of all fishes decreased, as expected, significantly. Besides mechanical encroachments the main problem for the fishes caught at greater depths was the gas supersaturation in the blood and tissue causing blockage of the gill capillary vessels, exophthalmus, visible gas bubbles in the skin and eyes, and in some cases profusion of the intestines through the snout due to rapid dilatation of the swimbladder.

Kulka, D. and Tillman, J.M. 1999. Canadian research report for 1998 Newfoundland Region. NAFO SCS documents 99/20: 11 p.

Kulka, D. and Tillman, J.M. 2000. Canadian research report for 1999 Newfoundland Region. NAFO SCS documents 00/21: 11 p.

Kulka, D.W. 1985. The effect of changing effort patterns of catch composition in the roundnose grenadier fishery, 1978-83. NAFO SCR documents 85/16: 19 p.

Kulka, D.W. 1986. A summary of the observed 1983-84 Greenland halibut fisheries in NAFO subareas 0, 2 and 3. Can. Ind. Rep. Fish. Aquat. Sci. 171: 240 p.

In order to determine if the Canadian offshore fleet has been exploiting the Greenland halibut resource effectively, current fishing patterns for all countries were compared against depth and area specific catch rates, and levels of by-catch.

Kulka, D.W. 2001. Distribution of Greenland halibut and by-catch species that overlap the 200-mile limit spatially and in relation to depth-effect of depth restrictions in the fishery. NAFO SCR documents 01/40: 42 p.

It is thought that measures currently in operation in the NAFO Regulatory Area are not adequate for the protection of the juvenile fish. The largest fishery in the NRA and thus the one of greatest concern is that directed at Greenland halibut (*Reinhardtius hippoglossoides*). As well, the need to reduce by-catch of any species in the Greenland halibut and other fisheries has been noted. Because of the range of depths currently fished, the Greenland halibut fishery not only focuses on the juvenile component of the population but also takes significant by-catch. Information on the distribution of Greenland halibut including distribution of undersized (below 35 cm, the Canadian minimum landing size) and mature and immature components of the population is presented. The paper also elaborates on the distribution of thirteen other commercial species that occur in the NRA, those that may be taken as by-catch in the directed Greenland halibut or other NRA fisheries, including those that overlap the Southeast Shoal. Based on fall survey data, the analyses take the form of biomass partitioning by depth ranges and mapping the distribution of each species and spatial analyses employing GIS. The survey data suggest that restricting fishing effort to depths exceeding 700 m will significantly reduce the proportion of undersized Greenland halibut and also marginally increase proportion of mature fish taken. Relative amounts of some species of by-catch will be reduced. Others will increase.

Kulka, D.W., Alpoim, R., and Gonzalez, F. 2001. Distribution of Greenland halibut and by-catch species that overlap the 200 mile limit spatially and in relation to depth - effect of depth restictions in the fishery. Distribution of the fishable biomass of the main commercial species of fish in relation to depth. NAFO SCR documents 01/122: 19 p.

It is thought that measures currently in operation in the NAFO Regulatory Area are not adequate for the protection of the juvenile fish. The largest fishery in the NRA and thus the one of greatest concern is that directing for Greenland halibut (Reinhardtius hipplglossoides). As well, the need to reduce by-catch of any species in the Greenland halibut and other fisheries has been noted. Because of the range of depths currently fished, the Greenland halibut fishery not only focuses on the juvenile component of the population but also takes significant by-catch. This paper is a compendium of 12 papers presented recently to Scientific Council. Information on the distribution of Greenland halibut including distribution of undersized and mature and immature components of the population based on both survey and commercial information is presented. The paper also elaborates on the distribution of other commercial species that occur in the NRA, those that may be taken as by-catch in the directed Greenland halibut or other NRA fisheries, including those that overlap the Southeast Shoal.

Kuznetsova, E.N., Bondarenko, M.V., and Morozov, A.D. 2001. Age composition and growth rate of black halibut *Reinhardtius hippoglossoides* of the Norwegian-Barents sea stock. J. Ichthyol. 41: 143-149.

The age composition and growth rate of *Reinchardtius hippoglossoides* of the Norwegian-Barents Sea stock during the present period of depression are investigated. The average age in trawl catches was 7.4years in 1998. In the 1960s, during the period of high yields, it was 9.1-9.4 years. The linear and weight growth of males and females is similar up through the age of eight. At ages over 8 years, the females grow more rapidly than males. The highest rate of linear growth is observed up until the age of five years. The age-length relationship is approximately linear. The rate of weight growth is relatively low: up to nine-ten years. After ten years, when most males are already eliminated from the stock, the weight growth rate increases.

Kuznetsova, E.N., Bondarenko, M.V., and Morozov, A.D. 2001. Vozrastnoj sostav i temp rosta chernogo paltusa Reinhardtius hippoglossoides norvezhsko-barentsevomorskogo stada [Age composition and growth rate of the halibut *Reinhardtius hippoglossoides* from the Norway-Barents Seas population]. Vopr. Ikhtiol. 41: 192-198.
[In Russian]

Age composition and growth rate of the halibut *Reinhardtius hippoglossoides* of the Norway-Barents Seas population (Norway, Barents Seas, Norway, Russia) are studied in the current period of depressive state of its stocks. Average age of the halibut in the trawl catches was 7.4 years in 1998, and in 1960s during the period of its high stock abundance the average age increased up to 9.1-9.4 years. Linear and weight growth of males and females are similar till 8 years. Further females begin to grow faster than males. The most high rate of linear growth is found among fishes with the age till 5 years. The correlation between age and length of fishes is considered to be linear. Weight growth rate is comparatively low till 9-10 years. After 10 years, when the most part of males leave the stock, the weight growth rate begins to increase.

Laidre, K.L. and Heide-Jørgensen, M.P. 2005. Winter feeding intensity of narwhals (*Monodon monoceros*). Mar. Mamm. Sci. 21: 45-57.

Stomach contents from 121 narwhals *(Monondon monoceros*) harvested in the eastern Canadian High Arctic and West Greenland were used to quantify seasonal changes in feeding activity and prey selection. Stomachs collected from summer harvests were mostly empty with little evidence of recent feeding. Stomachs collected in late fall and winter harvests had considerable amounts of undigested material with evidence of recent feeding. In summer, Arctic cod (*Arctogadus glacialis*), polar cod (*Boreogadus saida*), and *Gonatus* squid spp. constituted the narwhal diet. In fall, *Gonatus fabricii* was the only prey item observed. In late fall and winter, Greenland halibut (*Reinhardtius hippoglossoides*) and *G. fabricii* were the dominant prey items, observed in 51% and 73% of stomachs collected, respectively. Greenland halibut taken by narwhals were on average 39 cm (SD 8) and 556 g (306) and *G. fabricii* were on average 23 g (15) with mean mantle lengths of 85 mm (24). The low diversity of prey species indicates narwhals have a restricted diet across all seasons. This study presents the first information on the winter diet of the narwhal and suggests Baffin Bay and Davis Strait are heavily utilized for feeding, in contrast to limited food intake during the summer period.

Laidre, K.L., Heide-Jørgensen, M.P., Jørgensen, O.A., and Treble, M.A. 2004. Deep-ocean predation by a high Arctic cetacean. ICES J. Mar. Sci. 61: 430-440.

A bioenergetic model for two narwhal (*Monodon monoceros*) sub-populations was developed to quantify daily gross energy requirements and estimate the biomass of Greenland halibut (*Reinhardtius hippoglossoides*) needed to sustain the sub-populations for their 5-month stay on wintering grounds in Baffin Bay. Whales in two separate wintering grounds were estimated to require 700 tonnes (s.e. 300) and 90 tonnes (s.e. 40) of Greenland halibut per day, assuming a diet of 50% Greenland halibut. Mean densities and length distributions of Greenland halibut inside and outside of the narwhal wintering grounds were correlated with predicted whale predation levels based on diving behavior. The difference in Greenland halibut biomass between an area with high predation and a comparable area without whales, approximately 19000 tonnes, corresponded well with the predicted biomass removed by the narwhal sub-population on a diet of 50-75% Greenland halibut.

Laidre, K.L., Heide-Jørgensen, M.P., Logdson, M.L., Hobbs, R.C., Heagerty, P., Dietz, R., Jørgensen, O.A., and Treble, M.A. 2004. Seasonal narwhal habitat associations in the high Arctic. Mar. Biol. (Berl.) 145: 821-831.

Movements and behavior of top marine predators are often closely linked with productive oceanic fronts or regional prey aggregations. Consequently, it is of interest to quantify habitat needs and preferences, which can facilitate predictions of conditions favoring persistence and success. Multivariate habitat models of movements and dive behavior of narwhals (*Monodon monoceros*, Linnaeus) in the eastern Canadian high Arctic and West Greenland were developed using data collected from satellite telemetry studies on three separate sub-populations. Twenty-six narwhals were captured between 1993 and 2000 and fitted with satellite-linked time-depth recorders. Geographic positions of whales at 24-h time steps were linked to dive behavior variables compressed on a daily scale, including numbers of dives to different target depths or durations, time near the surface, daily dive rate, and travel speed. Whale movements and behavior were linked to biophysical variables in a raster format using a GIS (bathymetry, bottom topography, bottom temperature, and distance from the coastline) and analyzed using linear and generalized linear mixed models, accounting for temporal autocorrelation and random variation among individuals. Models suggested that several physical variables described narwhal behavior, predominantly bathymetry and distance from the coastline (particularly deep or long dives). Other descriptor variables, such as size category and sex, also explained portions of the model variability, particularly for shallow dives, surface time, and dive rates. Bottom temperature (degreeC) was the strongest predictor of all dive behaviors when narwhal location data were restricted to periods with available temperatures. The bottom temperature range and gradient selected by narwhals on their wintering grounds often coincided with areas of concurrent high density of Greenland halibut (*Reinhardtius hippoglossoides*, Walbaum) and predictable open water in winter pack ice in Baffin Bay. These quantitative habitat models made it possible to reconcile the behavioral traits of narwhals with dynamic environmental factors.

Lajus, D.L., Lajus, J.A., Dmitrieva, Z.V., Kraikovski, A.V., and Alexandrov, D.A. 2005. The use of historical catch data to trace the influence of climate on fish populations: examples from the White and Barents Sea fisheries in the 17th and 18th centuries. ICES J. Mar. Sci. 62: 1426-1435.

We analysed catch records of Atlantic salmon (*Salmo salar)*, cod (*Gadus morhua*), and halibut (*Hippoglossus hippoglossus* and *Reinhardtius hippoglossoides*) from the 17th and 18th centuries from several locations of the Barents and White Seas areas. Historical records, found in Russian archives, allow analysis of long-term series of catches, and sometimes of the average weight of the fish. In total, we obtained data on catches of salmon for 51 years (for the period from 1615 to 1772) and of cod and halibut for 33 years (for the period from 1710 to 1793). These data are comparable with respect to fishing effort within the series. The data on Atlantic salmon are also comparable with statistical data for the period 1875-1915. We found notable fluctuations in catches and sometimes in the average weight of salmon. There was also fluctuation in catches of cod and halibut. Both observational comparison of catch series and temperature data and formal statistical analysis showed that catches tended to decrease during relatively colder periods.

Lambert, J. D. 2004 La pêche sportive hivernale dans le fjord du Saguenay en 2003 [The Saguenay Fjord winter sport fishery in 2003]. Rapport sur l'état des stocks 2004/036: 8 p. [In French]

Lambert, J. D. 2005. The Saguenay Fjord winter sport fishery in 2003. Stock status report 2004/036: 8 p.

Lambert, J. D. 2005. La pêche sportive hivernale dans le fjord du Saguenay en 2004 [The Saguenay Fjord winter sport fishery in 2004]. Secretariat canadien de consultation scientifique avis scientifique 2005/019: 9 p.
[In French]

Lambert, J. D. 2005. The Saguenay Fjord winter sport fishery in 2004. Canadian Science Advisory Secretariat science advisory report 2005/019: 8 p.

Lambert, J.D. and Bérubé, S. 2002. La pêche sportive hivernale dans le fjord du Saguenay [Ice fishing on the Saguenay Fjord]. Can. Tech. Rep. Fish. Aquat. Sci. 2445: 68 p.
[In French]

Ice fishing on the Saguenay Fjord attracts more than 50,000 fishermen-days annually, leading to different interventions to assure resource conservation as well as its sustainable development. A biological program was initiated in 1995 from a partnership between associations of local fishers, the Société touristique du fjord, the Société d'electrolyte et de chimie Alcan Ltée., the Société de la faune et des parcs du Québec, the Société des établissements de plein air du Québec and the Department of Heritage Canada (Parks Canada) comanager of the Saguenay-St. Lawrence Marine Park, and the Dept. of Fisheries and Oceans, responsible for the scientific study. The biological program consisted of two working parties that required the participation of 32 volunteers from the local population. The first team consisted of eight samplers who collected catch and effort data on 20 occasions throughout the fishing season. The second team was composed of 24 fishermen who registered the length-weight, and condition of captured fish.

Lapteva, A.M. 2004. Soderzhanie myshyaka v myshtsakh, pêcheni i ikre dvenadtsati vidov promyslovykh ryb Barentseva morya [Arsenic content in muscles, liver and eggs of twelve commercial fish species in the Barents Sea]. Vopr. Rybol. 5: 165-173.
[In Russian, English summary]

The content of total arsenic have been determined in twelve commercial fish species (*Pollachius virens, Melanogrammus aeglefinus, Reinhardtius hippoplossoides, Anarhichas, Lycodes reticulatus*) from the Barents Sea (Russia) and the results are presented. Changes in arsenic concentrations depend on the size, age, feeding habits of fish as well as on the season and place of catch. It is found that if benthic organisms prevail in the fish diet, arsenic concentrations are higher.

Lassen, H. 1995. Greenland halibut Subareas 2+3 calculation of SSB as a function of relative effort. NAFO SCR documents 95/79: 4 p.

This paper is prepared in an attempt to answer a special request by Canada on how SSB for the 1990 year-class could be saved. The request asked "What changes in management of the Greenland halibut fishery (*Reinhardtius hippoglossoides*) in 1995 and future years would be needed to minimize catches of this year class while it is young and rapidly growing and allow it to make a) 25%, b) 50% or c) 75% of the contribution to future spawning biomass that it would if none of it was caught at immature ages". An answer to this request could be based on calculation of spawning biomass per recruit comparing the biomass at the age at first maturity for different scenarios of the fishing mortalities to which this cohort is exposed between age 5 (year class 1990 in 1995) and age 10 (age at first maturity). Although the request specifically addresses the year class 1990 calculations based on a recruiting age of 2 are also included. Age group 2 is the first age which appears in the Spanish age compositions of their catches in 1994. Such calculations are therefore relevant for future year classes.

Lawson, J.W. and Hobson, K.A. 2000. Diet of harp seals (*Pagophilus groenlandicus*) in nearshore northeast Newfoundland: Inferences from stable-carbon (delta super(13)C) and nitrogen (delta super(15)N) isotope analyses. Mar. Mamm. Sci. 16: 578-591.

Trophic position, and often the source of feeding of predators in food webs, can be estimated using measurements of stable isotope ratios of nitrogen and carbon in predators and their prey. Muscle samples from 60 harp seals (*Pagophilus groenlandicus*) collected during May 1995 in nearshore waters of New-foundland, Canada, were analyzed for delta super(13)C and delta super(15)N values. These values were compared with those for 63 prey samples representing seven species generally collected near the same area. Using diet-tissue isotopic fractionation factors derived from previous studies using captive animals, we infer a greater dependence of harp seals on lower trophic-level prey during April compared with results expected from exclusive diets of Atlantic cod (*Gadus morhua)*, Atlantic herring (*Clupea harengus*), Greenland halibut (*Reinhardtius hippoglossoides*), or northern shrimp (*Pandalus borealis*). Our mean delta super(15)N value for harp seals is lower than previous findings for seals collected on the winter whelping patch and may be a function of interannual or seasonal differences in diet.

Subadult seals (aged 1-4 yr) had significantly lower delta super(15)N values than adults (5+ yr), suggesting that older seals were feeding at a slightly higher trophic level.

Lawson, J.W. and Stenson, G.B. 1997. Diet of northwest Atlantic harp seals (*Phoca groenlandica*) in offshore areas. Can. J. Zool. 75: 2095-2106.

The offshore diet of harp seals (*Phoca groenlandica*) in the northwest Atlantic was determined by reconstructing the contents of prey-containing stomachs (399 of 724) recovered during 1980-1995. The importance of prey species varied seasonally and geographically. Pups (*Reinhardtius hippoglossoides)*, and Atlantic cod (*Gadus morhua*) on the southern Labrador Shelf. On the Grand Banks they consumed pleuronectids, sand lance, and capelin. Atlantic cod were rarely eaten by seals not caught by commercial trawlers. In contrast to the seals' nearshore diet, capelin were the principal prey on the Grand Banks and Labrador Shelf. Sand lance and Greenland halibut were also important. The contrast between near- and off-shore diets illustrates the importance of geographical variation in the contribution of a single prey species to the diet, especially in attempts to extrapolate consumption of specific prey.

Lawson, J.W., Miller, E.H., and Noseworthy, E. 1997. Variation in assimilation efficiency and digestive efficiency of captive harp seals (*Phoca groenlandica*) on different diets. Can. J. Zool. 75: 1285-1291.

Digestive efficiency (DE) is influenced by many factors including food type or quality. Assimilation efficiency (AE) and DE of 12 captive harp seals (*Phoca groenlandica*) were estimated for five prey types in large outdoor seawater tanks. In trials of >9 days' duration, the seals were fed Atlantic cod (*Gadus morhua)* , Arctic cod (*Boreogadus saida*), Greenland halibut (*Reinhardtius hippoglossoides*), Atlantic herring (*Clupea harengus)*, and capelin (*Mallotus villosus)*. Fish were marked with inert tracers so that faecal samples could be matched to individual animals. AE (digestibility of dry matter) was estimated from the relative concentration of Mn super(2+) in food and faeces. DE (digestible energy) was estimated from the relative concentrations of both Mn super(2+) and energy in food and faeces. AE and DE values were high, but varied among the fish species (DE: Atlantic cod 93.5%; Arctic cod 93.5%; halibut 94.7%; capelin 95.7%; herring 96.6%). Both estimates of digestive efficiency were positively correlated with prey energy density. For most prey, AE and DE were not correlated with meal size, number of prey in a meal, size of prey, or seal body mass. However, digestive efficiency was greater in seals fed smaller Atlantic cod, or meals of greater mass. Quantifying estimates of digestive efficiency is important for formulating energy-based population consumption models, and so should be improved. It is recommended that more pinniped species be studied in captivity, that experiments last longer, and that the number of individuals studied be increased so that individual differences can be investigated.

Lawson, J.W., Magalhaes, A.M., and Miller, E.H. 1998. Important prey species of marine vertebrate predators in the northwest Atlantic: Proximate composition and energy density. Mar. Ecol. Prog. Ser. 164: 13-20.

Prey energy density values are crucial inputs to bioenergetic consumption models. Vertebrate predators in the northwest Atlantic consume a variety of prey species, but the proximate composition (PC; proportions of lipid, protein, ash and water) and energy density (ED; kJ/g) of prey, and their variability, are known poorly. In this study, key prey species from Newfoundland and Labrador were studied: Atlantic cod *Gadus morhua*, American plaice *Hippoglossoides platessoides*, sand lance *Ammodytes dubius*, Arctic cod *Boreogadus saida*, northern shrimp *Pandalus borealis*, redfish *Sebastes*, Greenland halibut *Reinhardtius hippoglossoides*, squid *Illex illecebrosus* and *Gonatus fabricii*, capelin *Mallotus villosus*, Atlantic herring C*lupea harengus* and daubed shanny *Lumpenus maculatus*. PC and ED varied greatly among species and were influenced by size, season, geography and year. Herring, capelin and *G. fabricii* had the highest ED, whereas Atlantic cod, plaice, sand lance and shrimp had the lowest. Halibut and *I. illecebrosus* increased in ED with size. EDs of capelin and redfish varied seasonally; that of plaice and sand lance did not. Herring and halibut had higher ED in the early 1990s than in recent years. Such variation in prey ED has important implications for digestive efficiency, foraging energetics, and dietary preferences of vertebrate predators.

Lawson, J.W., Anderson, J.T., Dalley, E.L., and Stenson, G.B. 1998. Selective foraging by harp seals *Phoca groenlandica* in nearshore and offshore waters of Newfoundland, 1993 and 1994. Mar. Ecol. Prog. Ser. 163: 1-10.

The harp seal *Phoca groenlandica*, which is numerous and widespread in the Northwest Atlantic, may have significant influences on the structure of this ecosystem. To quantify this influence, we must understand the functional relationship between harp seals and their prey. If seals are discriminating in their choice of prey, then their consumption of a particular species will not necessarily vary in relation to its availability or catchability. By applying Chesson's index of selectivity to stomach contents and research trawl data collected in several near- and offshore locations, we found that harp seals preferentially selected capelin *Mallotus villosus* relative to other prey species, irrespective of their local abundance, when given the choice. Arctic cod *Boreogadus saida* were also preferred in nearshore areas, but not in the offshore. In general, these predators were neutrally selective towards Atlantic cod *Gadus morhua*, American plaice *Hippoglossoides platessoides* and Greenland halibut *Reinhardtius hippoglossoides*. These patterns rationalize the dietary patterns reported for harp seals generally. They also explain the harp seals' switch from a reliance on capelin to Arctic cod seen in the mid 1980s, when evidence suggests these cod became more abundant than capelin in nearshore waters (where their respective energy densities are similar).

Lear, W.H. 1970. Catch statistics, length and age composition of Greenland halibut in the Newfoundland area. Can. Tech. Rep. Fish. Aquat. Sci. 179: 27 p.

The Greenland halibut were sampled from commercial catches at various fish plants in Trinity and Conception bays. The fish were brought by truck to these plants from fishing communities in Trinity, Bonavista and Notre Dame bays. The fish were measured from the snout to the mid-fork of the tail to the nearest centimetre, sexed and a random sample of 10% was examined in detail for the fork length, sex and maturity, otoliths and, when circumstances permitted, for whole and gutted weights. Category samples were sometimes taken of fish over 80 cm in length or males or females showing signs of maturing. Age was determined from the left sacculus otolith after it was ground on a flat revolving carborundum stone. The otolith was then placed in a small black watchglass containing ethyl alcohol which helped to clear the hyaline zones and make the annual zones distinguishable from each other. The right sacculus otolith, because of its shape and the position of the nucleus, was rarely used for age-readings since the zones were more crowded and less distinguishable.

Lear, W.H. 1970. Fecundity of Greenland halibut (*Reinhardtius hippoglossoides*) in the Newfoundland-Labrador area. J. Fish. Res. Board Can. 27: 1880-1882.

Fecundity estimates of 45 Greenland halibut from the Newfoundland-Labrador area were related to length and age. Fecundity increased with both length and age and varied from 15,000 to 215, 000 eggs.

Lear, W.H. 1970. The biology and fishery of the Greenland halibut *Reinhardtius hippoglossoides* (Walbuam) in the Newfoundland area. Thesis (M.Sc.) Memorial University of Newfoundland, St. John's, NL.

Various aspects of the biology of the Greenland halibut stock in the Newfoundland-Labrador area were investigated. The distribution of the Greenland halibut in relation to depth and temperature is described for several areas.

Lear, W.H. and Pitt, T.K. 1971. Distribution of the Greenland halibut in the Newfoundland Labrador area in relation to depth and temperature. Can. Tech. Rep. Fish. Aquat. Sci. 274: 34 p.

The largest concentration of Greenland halibut in the Newfoundland area occurred in depths ranging from 150 to 325 fathoms and bottom temperatures from 1 to 3 C. The average catch per gillnet decreased markedly from 1966 to 1968 as evidenced by reduced catches by research and commercial vessels.

Lear, W.H. and Pitt, T.K. 1975. Otolith age validation of Greenland halibut (*Reinharditius hippoglossoides).* J. Fish. Res. Board Can. 32: 289-292.

Length and age distribution, together with evidence indicating the annual formation of an opaque and translucent hyaline zone on the otoliths of *R.hippoglossoides*, point to the validity of using otoliths in age determination. The high incidence of opaque zones during July-Oct suggests that these fish grew fastest during this period. Young fish appeared to have a longer annual growth period than the older specimens.

Lebeuf, M., St-Pierre, Y., Clermont, Y., and Gobeil, C. 1999. Concentrations de biphenyles polychlores (BPC) et pesticides organochlores chez trois espèces de poissons de fond de l'estuaire et du golfe du Saint-Laurent et du fjord du Saguenay. Can. Data Rep. Fish. Aquat. Sci. 1059: 114 p.
[In French, English summary]

Concentrations of polychlorinated biphenyls (PCBs) and organochlorine pesticides were determined in muscle and liver of Atlantic cod (*Gadus morhua*), American plaice (*Hippoglossoides platessoides*) and Greenland halibut (*Reinhardtius hippoglossoides*), which were sampled from the Estuary and Gulf of St. Lawrence, and from the Saguenay Fjord. The analyses included measurements of more than 35 organochlorine compounds, including approximately twenty PCB congeners, in 56 tissue samples. This report summarises data from over 1 900 individual measurements. All of the tissues contain measurable quantities of most of the PCBs and organochlorine pesticides. All fish have higher levels of contaminants in liver compared to muscle tissue. Liver concentrations are highest in cod and lowest in plaice, while concentrations in muscle are highest in halibut and lowest in cod. Regardless of the species, concentrations of contaminants are similar in samples from the Saguenay and the Estuary but are generally higher than in samples from the northeastern Gulf. According to the Canadian guidelines for the protection of human health, levels of total PCB and of DDT and its metabolites in fish tissues should not exceed 2 000 and 5 000 ng/g (wet weight), respectively. The levels of PCBs and organochlorine pesticides measured in muscle and liver samples of cod, plaice and halibut in this study are less than these guidelines. In fish livers, the highest concentrations of PCBs are less than one-half of the guideline, while levels of DDT and its metabolites are less than one-tenth of the guideline. In fish muscle, concentrations are up to 10 and 100 times lower than the guidelines, for PCBs and for DDT and its metabolites, respectively.
Notes: In French

Lehmann, K. 1986. Denmark (Greenland) research report for 1985. NAFO SCS documents 86/16: 7 p.

Lehmann, K. 1987. Denmark (Greenland) research report for 1986. NAFO SCS documents 87/14: 11 p.

Lehmann, K. 1988. Denmark (Greenland) research report for 1987. NAFO SCS documents 88/16: 8 p.

Leim, A.H. and Scott, W. B. 1966. Fishes of the Atlantic Coast of Canada. Bulletin (Fisheries Research Board of Canada); 155: 530 p.

> Lists all species of fish taken off the Canadian Atlantic coast from Cape Chidley to Grand Manan. The distribution and commercial use of species is described. Most species are illustrated, and keys identify individual species. A glossary of technical terms and over 500 references to the literature and an index are included.

Leim, A.H. and Scott, W. B. 1972. Poissons de la cote atlantique du Canada [Fishes of the Atlantic Coast of Canada]. Bulletin (Fisheries Research Board of Canada); 155F: 530 p. [In French]

Lemche, E. 1986. Denmark (Greenland) request for scientific advice on management of certain stocks in 1987. NAFO SCS documents 86/12: 2 p.

Lemche, E. 1987. Denmark (Greenland) request for scientific advice on management of certain stocks in 1988. NAFO SCS documents 87/05: 1 p.

Lemche, E. 1993. Denmark (Greenland) request for scientific advice on management of certain stocks in 1994. NAFO SCS documents 2 p.

Lens, S. 1997. Interactions between marine mammals and deep water trawlers in the NAFO regulatory area. ICES CM 1997/Q:8: 10 p.

> Starting in 1990, a deep water trawl fishery for Greenland halibut (*Reinhardtius hippoglossoides*) in the NAFO Regulatory Area was developed by Spain. At the same time an observer's program to collect information about the fishery was put in operation. In 1993 and 1994 the observers collected information on sightings and incidental catches of marine mammals. The observers made 264 sightings of marine mammals, belonging to 10 cetaceans and 3 pinnipeds species, with the sperm whales, (*Physeter macrocephalus*) the northern bottlenose whale, (*Hyperodon ampullatus*) the pilot whales (*Globicephala melaena*) and the harp seals (*Poca groenlandica*) among the most frequently observed species. Information about fishing operations and their interactions with marine mammals was obtained in more than 14 000 individual hauls. Their presence in the nets was recorded on 57 occasions. Incidental catches didn't occur in 46 of the 74 fishing trips observed. The majority of the remaining 37.8 % trips registered one catch (n=19) and only on a few trips were there more than one. The rate of sets with incidental catches over the the total number of sets observed was 0.31 %. A mortality of 42 specimens is reported, belonging to four cetacean species (Atlantic white-sided dolphin, (*Lagenorhynchus acutus)* striped dolphin, (*Stenella coeruleoul*) common dolphin (*Delphinus delphinus*) and long-finned pilot whale (*Globicephala melanae)*) four pinnipeds species (harbour, *(Poca vitulina*) harp, (*Phoca groenlandica*) ringed (*Phoca hispida*) and grey seals (*Halichoerus grypus*)) and unidentified cetacean and pinnipeds species. The rate of sets with mortality was 0.27 %. The 73.8 % of this mortality corresponds to the seals. The data obtained were compared with the information available from similar fisheries, it being estimated that the Greenland halibut fishery has a relatively low level of interactions and marine mammal mortality.

Leth, H. 1994. Denmark (Greenland) request for scientific advice on management of certain stocks in 1995. NAFO SCS documents 94/5: 1 p.

Lilly, G. R. and Carscadden, J. E. 2002. Predicting the future of marine fish and fisheries off Labrador and eastern Newfoundland under scenarios of climate change : information and

thoughts for the Arctic Climate Impact Assessment (ACIA) = Prediction de l'avenir des poissons marins et de leur pêche au large du Labrador et de l'est de Terre-Neuve en fonction des scenarios du changement climatique : informations et precisions pour l'Evaluation des incidences climatiques dans l'Arctique (EICA). Canadian Science Advisory Secretariat research document; 2002/111: 35 p.
[In French and English]

Lim, H.K. and Haard, N.F. 1984. Protein insolubilization in frozen Greenland halibut (*Reinhardtius hippoglossoides*). J. Food Biochem. 8: 163-187.

Frozen storage of minced Greenland halibut (*R. hippoglossoides*) at -10 degree C resulted in a rapid loss in salt solubility of "myofibrillar proteins" (approximately 50% in 15 days) and in a gradual loss in water solubility of "sarcoplasmic proteins" (approximately 40% in 120 days). The water and salt inextractable protien from frozen minced (R) was completely soluble in 4% sodium dodecylsulfate (SDS) when a disulfide bond reducing agent such as mercaptoethanol (ME) was present. Other reagents, including urea and Triton X 100, were less effective in solubilizing the protein from mince after frozen storage.

Lisovsky, S. and Pavlenko, A. 2003. Selectivity of the cod-ends with the 130-150 mm mesh size in specialized trawl fishery for Greenland halibut in Division 3L of NAFO Regulatory Area. NAFO SCR documents 03/28: 24 p.

Presented are the results of estimating the selectivity of the trawl cod-ends with 130 mm, 135 mm, 136 mm, 145 mm and 150 mm mesh size for the Greenland halibut (*Reinhardtius hippoglossoides*) from the NAFO Regulatory Area and the objects of by-catch in its specialized fishery: roughhead grenagier (*Macrourus berglax*), redfishes (*Sebastes*) and American plaice (*Hippoglossodes plassetoides*). The works were executed by two stages. Selectivity was estimated with the aid of the bag-shaped cover. The calculation was made applying generalized logistic Richards function using the SELECT model and Solver. sel. Programmes. The likelihood estimations were obtained by minimizing logarithmic likelihood function. In experiments the selectivity coefficient for the trawl cod-ends with 130-150 mm mesh size for Greenland halibut varied from 2.9 to 3.3, the selectivity range from 6.0 to 10.0 cm and the fish length corresponding to 25% retention from 35.9 to 45.1 cm. The data analysis showed that 130-150 mm increase in the mesh size when fishing Greenland halibut led to the essential instantaneous losses and the long-term profits of the fishery were negligible. The selectivity parameters of the trawl bags for roughhead grenadier, redfish and American plaice were the same as the results obtained before.

Lisovsky, S., Pavlenko, A., and Kondratyuk, Y. 2002. The analysis of the results from the investigation into selectivity of trawl cod-ends with 120-150 mm mesh size in the fishery of Greenland halibut in the NAFO Regulatory Area. NAFO SCR documents 02/29: 17 p.

The paper describes the results of selectivity tests for cod-ends with 130.8, 145.2 and 150.2 mm mesh size in the Greenland halibut (*Reinhardtius hippoglossoides*) fishery in the NAFO Regulatory Area. Selectivity parameters for males and females were not found to differ significantly; therefore, the results were analyzed regardless of sex. The calculations were made by the generalized logistic (Richard's) and logistic functions of dependence of fish retention on length. Estimating the likelihood by both models through minimizing Akaike's Information Criterion (AIC) showed that Richard's function more precisely described fish retention. In a series of experiments the length of fish corresponding to 50% retention ranged from 41.7 cm for 130.8 mm mesh to 45.2 and 46.7 cm for, respectively, 145.2 and 150.2 mm meshes. Selectivity range was 6.1-8.4 cm and selectivity coefficient varied from 3.1 to 3.2. Calculated fish length corresponding to 25% retention ranged from 38.2 for 130.2 mm mesh to 41.8 cm for the one with 150.2

mm size. Processing the data obtained indicated that an increase of trawl mesh size from 130 m and over would not be profitable in the long term. A trawl fishery for Greenland halibut would be economically inexpedient owing to a significant reduction in the efficiency of trawl with larger mesh.

Lisovsky, S., Kondratyuk, Y.A., and Pavlenko, A.A. 2004. Selectivity of cod-ends with standard 150, 160 and 170 mm mesh size in Greenland halibut trawl fishery in Division 3L of the NAFO Regulatory Area and possible results of mesh size increase in more than 130 mm. NAFO SCR documents 04/6: 18 p.

Given are the data on selectivity of cod-ends with 152; 163 and 170 mm mesh size in the Greenland halibut (*Reinhardtius hippoglossoides*) target fishery in Div. 3L of NAFO Regulation area. The results from investigations were processed using SELECT model, by logistic and generalized logistic (Richard's) function of the likelihood of studied fish retention depending on their size. The parameters of functions were obtained by minimizing the likelihood function. Selectivity parameters derived by authors for 152 mm mesh: fish length corresponding to 25% and 50% retention - L sub(25) = 35.4 cm; L sub(50) = 42.8 cm; selectivity coefficient k sub(S) = 2.8; selectivity range SR = 14.8 cm; for 163 mm and 170 mm mesh: L sub(25) = 39.1 and 40.2 cm; L sub(50) = 47.4 and 48.4 cm; K sub(S) = 2.8 and 2.9; SR = 15.9 and 15.4 cm, respectively. Calculations of instantaneous losses showed that enlarging mesh size from 130 to 173 mm would result in efficiency decrease almost in 5 times, and minor long-term profits of up to 1-3% might be only obtained with fishing mortality growing in not less than 2-4 times, as compared to the current one.

Lisovsky, S.F., Sakhno, V.A., and Gorchinsky, K.V. 1996. Preliminary results from selectivity of "SORT-V" sorting grid system on the basis of single grid regarding the Greenland halibut (*Reinhardtius hippoglossoides*) in the NAFO Regulatory Area (Div. 3L). NAFO SCR documents 96/37: 10 p.

Results from selectivity of "SORT-V" sorting grid system based on a single grid regarding Greenland halibut, *Reinhardtius hippoglossoides* during fishery in the NAFO regulatory area (Div. 3L) are presented. Grids of 1.2m long and of 1m width with 35-40mm bar distance were used. For the system with 35mm bar distance the fish length corresponding to 50% retention made up 33.1-33.8cm and selectivity range - 3.6-4.2cm. For the system with 40mm bar distance, these parameters were 33.8 and 12.9cm, respectively. Specimens below 30cm long escaped completely. The 'SORT-V" system with 35mm grid completely provides for a fulfilment of fisheries rules in regard to halibut minimum length allowable for catch.

Lisovsky, S.F., Esin, V.V., and Pavlenko, A.A. 2001. Selectivity of trawl bags with different mesh size in trawl fishery for Greenland halibut in the NAFO regulatory area. NAFO SCR documents 01/30: 12 p.

Data for selectivity of trawl bags with the mesh size of 120 mm and 130 mm in the Greenland halibut fishery in the NAFO Regulatory Area are presented. Selectivity parameters derived by the authors in the first test for trawl bags with the mesh size 132 mm are as follows: 50% retention length (L 50%) - 40.0 cm; selectivity coefficient (Ks)- 3.03; selectivity range (ds) - 10.5 cm; 25% retention length (L25%) - 34.0 cm. For trawl bags with the mesh size 121 mm these parameters were 35.5 cm, 2.93, 6.5 cm and 33.0 cm, respectively. In the second test performed in the same area in two weeks time selectivity parameters were similar. In the Greenland halibut fishery by trawls with the minimal mesh size of 130 mm a minimum landing size corresponding to 25% retention should be 32.0-34.0 cm. With this minimum landing size by-catch of juvenile halibut would not exceed 10% in number, as according to Conservation and Enforcement Measures.

Lisovsky, S.F., Kondratyuk, Y.A., and Pavlenko, A.A. 2004. Selectivity of cod-ends with standard 150, 160 and 170 mm mesh size in Greenland halibut trawl fishery in Division 3L of the NAFO regulatory area and possible results of mesh size increase in more than 130 mm. NAFO SCR documents 04/6: 18 p.

Given are the data on selectivity of cod-ends with 152; 163 and 170 mm mesh size in the Greenland halibut target fishery in Div.3L of NAFO Regulation area. The results from investigations were processed using SELECT model, by logistic and generalized logistic (Richards) function of the likelihood of studied fish retention depending on their size. The parameters of functions were obtained by minimizing the likelihood function. Selectivity parameters derived by authors for 152 mm mesh: fish length corresponding to 25% and 50% retention L25 = 35.4 cm; L50 = 42.8 cm; selectivity coefficient KS = 2.8; selectivity range SR = 14.8 cm; for 163mm and 170 mm mesh: L25 = 39.1 and 40.2 cm; L50 = 47.4 and 48.4 cm; KS = 2.8 and 2.9; SR = 15.9 and 15.4 cm, respectively. Calculations of instantaneous losses showed that enlarging mesh size from 130 to 173 mm would result in efficiency decrease almost in 5 times, and minor long-term profits of up to 1-3% might be only obtained with fishing mortality growing in not less than 2-4 times, as compared to the current one.

Livingston, P.A. 1993. Importance of predation by groundfish, marine mammals and birds on walleye pollock *Theragra chalcogramma* and Pacific herring *Clupea pallasi* in the eastern Bering Sea. Mar. Ecol. Prog. Ser. 102: 205-215.

Consumption of walleye pollock *Theragra chalcogramma* and Pacific herring *Clupea pallasi* by groundfish predators in the eastern Bering Sea was quantified and described using data obtained in 1985-88. Groundfish predators considered here include walleye pollock *Theragra chalcogramma*; Pacific cod *Gadus macrocephalus;* yellowfin sole *Pleuronectes asper*; flathead sole *Hippoglossoides elassodon*; rock sole *Pleuronectes bilineatus*; Alaska plaice *Pleuronectes quadrituberculatus*; arrowtooth flounder *Atheresthes stomias*; and Greenland turbot *Reinhardtius hippoglossoides*. Marine mammal and bird consumption of pollock and herring was estimated for 1985 and compared with groundfish consumption. Groundfish predation on pollock during this time period was dominated by cannibalism on age-0 pollock by adult pollock. The highest predation rate occurred in 1985 when the largest pollock year class, as assessed at age 1, during the time period was produced. Predation mortality estimates by age on the 1985 year class were higher than adjacent year classes. Apparently, predators responded to the increased abundance of the 1985 pollock year class by switching to predation on that year class. The impact of this predation appeared to dampen the size of the 1985 year class at age 3 relative to other adjacent year classes. Marine mammal and bird predation on pollock was small relative to pollock cannibalism. However, marine mammal predation on older pollock was more important, almost doubling the estimated predation mortality rate of age-2 fish. Herring consumption by groundfish predators tended to be sporadic in time and space and may have depended on encounter rates of herring schools rather than overall biomass. Pacific cod was the most consistent groundfish predator on herring.

Livingston, P.A. and Jurado-Molina, J. 2000. A multispecies virtual population analysis of the eastern Bering Sea. ICES J. Mar. Sci. 57: 294-299.

The eastern Bering Sea shelf supports a large biomass of several groundfish populations, particularly walleye pollock (*Theragra chalcogramma*). The main trophic interactions between dominant groundfish populations in this region involve walleye pollock as prey. A multispecies virtual population analysis model (MSVPA) covering the period 1979-1995 has been parameterized for the eastern Bering Sea in order to move closer to providing multispecies management advice for this region. The MSVPA model is based on extensive diet data from 70 predator/prey/year/quarter combinations and currently includes the following species as predators: walleye pollock (*Theragra chalcogramma*), Pacific cod (*Gadus macrocephalus*), Greenland turbot (*Reinhardtius hippoglossoides*), yellowfin sole (*Pleuronectes asper*), arrowtooth flounder (*Atheresthes stomias*), and northern fur seal (*Callorhinus ursinus*). Arrowtooth flounder and northern fur seals are entered as "other predators", which means that population and mortality estimates are not directly made for these species. Estimates of their consumption rates, diet, and population abundance are input, however, so that their predation on prey species in the model can be calculated. Prey species are walleye pollock, Pacific cod, Greenland turbot, yellowfin sole, rock sole (*Lepidopsetta bilineatus*), and Pacific herring (*Clupea pallasi*). Results show that large numbers of walleye pollock, particularly age-0 and age-1 fish, are consumed and cannibalism by adult pollock constitutes the largest source of predation mortality for age-0 fish. Predation plays an important role in explaining the recruitment dynamics of pollock. Further advances may be made when these estimates are linked to models that examine the effect of climate-related factors influencing larval survival.

Livingston, P.A. and Lang, G.M. 1996. Food habits of key groundfish species in the eastern Bering Sea slope region. NOAA (National Oceanic and Atmospheric Administration) Technical memorandum NMFS-AFSC 67: 116 p.

Logimer Inc. and Canada. Ministère des pêches et des oceans. Region du Québec. 1987. Potentiel d'utilisation du filet tremail pour la capture du turbot (*Reinhardtius hippoglossoides*) : rapport synthese [preliminaire]. Logimer Inc., Québec. 17 p. [In French]

Looser, R., Froescheis, O., Cailliet, G.M., Jarman, W.M., and Ballschmiter, K. 2000. The deep-sea as a final global sink of semivolatile persistent organic pollutants? Part II: Organochlorine pesticides in surface and deep-sea dwelling fish of the North and South Atlantic and the Monterey Bay Canyon (California). Chemosphere 40: 661-670.

The understanding of the global environmental multiphase distribution of persistent organic pollutants (POPs) as a result of the physico-chemical properties of the respective compounds is well established. We have analysed the results of a vertical transport of POPs from surface water to deepwater in terms of the contamination of the biota living in the respective environmental compartments. Samples were taken from the North and the South Atlantic and from the uprising water region of the continental shelf of California (Marine Sanctuary Monterey Bay and its Canyon). The contents of persistent organochlorine pesticides (DDTs, chlordanes, toxaphenes, HCHs, and HCB) in surface-living fish are compared to those in deepwater fish of the same geographic area. The deepwater biota show significantly higher burdens as compared to surface-living species of the same region. There are also indications for recycling processes of POPs of the class of organochlorine pesticides in the biophase of the abyss as well. It can be concluded that the bio- and geophase of the deep-sea may act as an ultimate global sink for persistent semivolatile contaminants in the marine environment like the soil on the continents.

Lu, M. and Jang, H. 2004. Investigation and analysis of EPA and DHA content in dietary fish of a college cafeteria. Taiwanese Journal of Agricultural Chemistry and Food Science 42: 1-6. [In Thai, English summary]

In this study, the levels of EPA (eicosapentaenoic acid) and DHA (docosahexaenoic acid) from fish served in a college cafeteria were investigated [Taiwan]. The contents of total lipids and fatty acids of edible portions of fish (tilapia, *Oreochromis mossambicus*; ribbon fish, *Trichiurus lepturus*; marlin, *Makaira mazara*; Pacific saury, *Cololabis saira*; halibut, *Reinhardtius hippoglossoides*; shark, *Hemitriakis japonicus* [*H. japanica*]; mackerel, *Scomber australasicus*) were determined by lipid extraction and gas chromatography, respectively. The results showed that the contents of total lipids, EPA and DHA in marine fishes such as Pacific saury, halibut and mackerel were higher than those in most fishes.

Pacific saury was found to contain 1425 mg of omega -3 fatty acids per 100 grams of edible portion. Consumption of Pacific saury and mackerel with higher levels of EPA and DHA was obviously less than consumption of ribbon fish and tilapia which contain lower levels of EPA and DHA. Daily EPA and DHA intakes from fish for each student were approximately 66.01 and 125.20 mg, respectively, indicating that EPA and DHA intakes were significantly lower than what is recommended.

Lund, H. and Andersen, M. 1993. Denmark/Greenland research report for 1992. NAFO SCS documents 93/16: 5 p.

Lussiaa-Berdou, J.P. 1979. Évolution récente de la population du flétan du Groenland (*Reinhardtius hippoglossoides)* et de sa pêche dans le Golfe du Saint-Laurent [Recent evolution of the population of the Greenland halibut (*Reinhardtius hippoglossoides*) and its fishery in the Gulf of St. Lawrence]. CAFSAC Res. Doc. 79/48: 10 p.
[In French]

Lussiaa-Berdou, J.P. 1981. Captures accessoires par les chalutiers québécois en 1979 [By-catch of Quebec trawlers in 1979]. CAFSAC Res. Doc. 81/66: 8 p.
[In French]

A review of reports on landings by different Quebec trawlers in 1979 shows that, for trawlers fishing for cod, only by-catches of American plaice represent more than 5% of total catches by weight and vary between 7% and 33% according to the region and the month during which fishing took place. By-catches by trawlers measuring more than 100 ft in length and fishing for redfish were practically nil, except when mixed fishing was involved. Landings of Greenland halibut by smaller trawlers normally represent more than 6%. When trawlers fish for pink shrimp, landings are much more varied. Redfish, cod and Greenland halibut very often represent more than 50% of landings by weight.

Lussiaa-Berdou, J.P., Courtois, R., Dubé, P., Fréchette, J., Lamoureux, P., and Tremblay, C. 1983. Revue de l'echantillonnage des captures commerciales d'espèces marines par la province du Québec [A review of the sampling of commercial catches of marine species by the province of Quebec]. Can. Spec. Publ. Fish. Aquat. Sci. 66: pp. 61-76.
[In French, English summary]

Data are presented on the history, objectives, methods, and volumes of commercial catch samplings of cod, *Gadus* , redfish *Sebastes marinus* , Greenland halibut *Reinhardtius hippoglossoides* , plaice *Hippoglossoides* , herring, *clupea* , lobster *Homarus americanus* , and pink shrimp *Pandalus borealis* . Sampling of demersal fish at landing, initiated following ICNAF recommendations, has suffered from a change of priority in fisheries research activities in Quebec between 1966 and 1974. The importance, especially for pink shrimp and demersal fish, of the link between the gathering of statistics on the fishing effort and sampling at landing, is stressed. These two activities are tackled by technicians permanently present in the main landing ports during the fishing season.

Lyberth, B. and Boje, J. 2005. An assessment of the Greenland halibut stock component in NAFO Division 1A inshore. NAFO SCR documents 05/58: 23 p.

This paper presents the assessment of Greenland halibut in the inshore part of NAFO Div. 1A. The area covers the fjords in the three distinctive geographical areas, Disko Bay,Uummannaq and Upernavik. Information from the commercial fishery (only landings, no effort information) and research survey (longline survey in Uummannaq and a newly initiated gillnet survey in Disko Bay) was available for the assessment. The state of the stocks were as follows. Disko Bay: In the recent two decades annual landings increased from about 2000 tons in 1987 to 10 500 tons in 1998 and 1999. Since then landings increased again from 2002 to 2004 to record high of nearly 13 000 tons. Recruitment indices from Disko Bay and offshore areas suggest high 1997 and onward year-classes, which the fishery might benefit in these years. Both gillnet and the longline surveys supported abundant incoming year-classes. In the winter and summer fishery mean lengths has decreased for the past three years. A newly established gillnet survey (since 2001) shows a slight increase in catch rates since 2002 The longline survey shows higher catch rates in 2001 and 2004 compared to the 1990s. Uummannaq: Catches have been increasing from less than 2 000 tons before 1987 to a record high of 8 425 tons in 1999, but have since stabilized at about 5 000 tons in recent three years. Development in mean length in the summer fishery has showed an overall negative trend until 1999. Since then mean length in catches has increased slightly. In the winter fishery the mean length has been has been relatively stable except for the winter 2002 and 2005 where mean length decreased. Survey results from 1993 to 1999 indicated an increase in abundance until 1998. In 2001 and further in 2003 survey abundance index decreased significantly to the lowest observed, but the 2004 index is at about average of the time series. Catch composition in the commercial fishery has changed significantly since the 1980s towards a higher exploitation of younger age groups, but has stabilized in recent decade. Upernavik: Landings increased from about 1 000 tons prior to 1992 to highest on record, 7 012 tons in 1998. Since then landings have decreased continually by more than 50% to 3 000 tons in 2003. In 2004 landings increased again the about 4 500 tons. Little recent information is available on the commercial fishery and no surveys have been carried out. Apart from total catches there is thus no information to evaluate present stock status. New fishing grounds in the northern part of the district (Kullorsuaq) are being exploited, individual weights from winter fishery 2002 to 2005 show a slightly declining trend.

Lydersen, C., Angantyr, L.A., Wiig, O., and Oeritsland, T. 1989. Feeding habits of northeast Atlantic harp seals *Phoca groenlandica* along the summer ice edge of the Barents Sea. ICES CM 1989/N:11: 14 p.

Stomachs from 58 harp seals *Phoca groenlandica* from the northern parts of the Barents Sea were collected between 20 August and 5 September 1987. Fifty-six of the stomachs contained identifiable contents. The amphipod *Parathemisto libellula* was the most common food items, found in 98% of the seal stomachs and constituted 57.9% of total volume. Fishes were found to be the second most important prey group, with Arctic cod *Boreogadus saida* as the dominant species followed by Nybelin's sculpin *Triglops nybelini* and Greenland halibut *Reinhardtius hippoglossoides*. Decapods, mainly Pandalus borealis , were also common as prey of harp seals. No sex or age related differences in choice of food were found. From knowledge of depths at locations seals were collected and presence of fresh benthic fish in the seal stomachs, harp seals were assumed to be able to collect food at depths below 300 m.

Lydersen, C., Angantyr, L.A., Wiig, O., and Oritsland, T. 1991. Feeding habits of northeast Atlantic harp seals (*Phoca groenlandica*) along the summer ice edge of the Barents Sea. Can. J. Fish. Aquat. Sci. 48: 2180-2183.

Stomachs from 58 harp seals (*Phoca groenlandica*) from the northern part of the Barents Sea were collected between Aug 20 and Sep 5, 1987. Fifty-six of the stomachs contained identifiable remains. The amphipod *Parathemisto libellula* was the most common food item, found in 98% of the seal stomachs and constituting 57.9% of the total volume. Fish were the second most important prey group, with Arctic cod (*Boreogadus saida*) as the dominant species followed by Nybelin's sculpin (*Triglops nybelini*) and Greenland halibut (*Reinhardtius hippoglossoides*). Decapods, mainly *Pandalus borealis*, were also common as prey of harp seals. No sex- or age-related differences in choice of food were found. From knowledge of the depths at locations where seals were collected and the presence of fresh benthic fishes in the seal stomachs, it is assumed that harp seals could forage at depths below 300 m.

Madeira, K. and Penfield, M.P. 1985. Turbot fillet sections cooked by microwave and conventional heating methods : objective and sensory evaluation. J. Food Sci. 50: 172-173.

Greenland turbot fillet sections were baked in conventional and microwave ovens. The microwave oven cooked the fish faster, required less energy, and demonstrated greater relative efficiency than did the conventional oven. Solid-drip and total cooking losses were greater and Kramer shear values and evaporative loss were lower for microwave-heated fish. No differences in sensory flakiness and moisture were found between oven treatments, but microwave-heated samples were rated softer and less chewy by a trained panel. Several significant correlations were found among sensory attributes and objective measure of quality. Greenland turbot (*Reinhardtius hippoglossoides*) was used. Bulk frozen turbot fillets were purchased in July, 1983 in 25-lb boxes that were pack-dated October 10, 1982. Sixteen fillets weighing between 504 and 672g were selected for trained panel and objective evaluation. From those 16 fillets, four were assigned randomly to each of four replications. In addition, three fillets weighing between 700 and 800g were selected for testing by a consumer panel. Selection of fish within these frozen weight ranges made it possible to assign half of each fillet to microwave heating and half to conventional heating. The fillets were individually wrapped in heavy-gauge aluminum foil then stored at -22 degree C in a household-type food freezer until the day prior.

Magnusson, J. 1998. Deep water fisheries at Iceland. ICES CM 1998/O:66: 15 p.

Magnusson, J.V. 1977. Notes on the eggs and larvae of Greenland halibut at Iceland. ICES CM 1977/F:47: 6 p.

The paper deals with 1) the results of the plankton sampling, i.e. the bathypelagic eggs of Greenland halibut; 2) The distribution of O-group Greenland halibut in the Irminger Sea; 3) Eggs counting and measurements of the egg diameter in ripe and ripening females.

Magnusson, J.V. and Sveinbjornsson, S. 1990. Report on the 0-group fish survey in Iceland and East Greenland waters, Aug.-Sep. 1990. ICES CM 1990/G:68: 18 p.

This paper is a continuation of annual report on routine invesigations on hydrography and the distribution and abundance of O-group fish in Icelandic and East Greenland waters in August- September. The 1990 abundance index of O-group cod was very low and that of haddock low. The capelin O-group index was relatively low while that of redfish was very high. The ocurence of other species appearing in the trawl catches during the survey is reported and their abundance indicated when possible. A multiple linear regression method of estimating the year class strength of cod predicts, that the abundance of the 1990 year class will be about 165 million 3 year old cod in the beginning of 1993.

Magwood, S. and George, S. 1996. In vitro alternatives to whole animal testing. Comparative cytotoxicity studies of divalent metals in established cell lines derived from tropical and temperate water fish species in a neutral red assay. Mar. Environ. Res. 42: 37-40.

A simple vital dye (neutral red) uptake method for investigation of the acute toxicity of seven divalent metal cations to cell lines derived from the turbot (TF) and bluegill (BF-2) was evaluated. The method was extremely reproducible between replicate experiments on a week to week basis as well as being reproducible between different laboratories. Whilst there were some species-dependent differences in the relative toxicities of the metals there were good correlations between toxicity and the chemical softness (capital sigma p) of the metal ions and also between in vivo and in vitro toxicities. These studies demonstrate that this simple and relatively inexpensive technique carried out in 96-well microplates may be extremely useful for evaluation of structure-toxicity relationships between related groups of compounds.

Mahe, J.C. 1998. French research report for 1997. NAFO SCS documents 98/10: 6 p.

Mahe, J.C. 2001. Greenland halibut in NAFO Subarea 2 and Divisions 3 KLMNO - short-term and medium-term projections from an extended survivor analysis. NAFO SCR documents 01/77: 5 p.

In order to provide some information for short and medium-term management of the stock of Greenland halibut (*Reinhardtius hippoglossoides*) in NAFO Subarea 2 and Divisions 3 KLMNO, a catch projection associated with a risk analysis were performed for a ten year period starting in 2000 on the basis of a statu quo fishing level corresponding to the level of fishing mortality assuming a catch in 2001 at the level of the TAC (40, 000 t). The input data were taken from an extended survivor analysis. The results show that on the statu quo assumption catches are expected to increase to around 44,000 t in 2003 and to slowly decrease after to fluctuate slightly around an average of 40,000 t.

Mahe, J.C. and Bowering, W.R. 2001. An assessment of stock status of the Greenland halibut resource in NAFO Subarea 2 and Divisions 3KLMNO based on extended survivors analysis. NAFO SCR documents 01/80: 18 p.

An Extended Survivors Analysis was applied to the commercial catch at age data for Greenland halibut (*Reinhardtius hippolgossoides*) in NAFO Subarea 2 and Divisions 3KLMNO from 1975-2000 to assess the current status of the stock. The analysis was calibrated using Canadian and European Union research vessel survey data. Stock biomass at ages 5 and older is estimated to have increased during the late 1980s and then declined rapidly during the period of high landings in the early 1990s. Estimated fishing mortality has followed the trend in landings, increasing rapidly in the early 1990s, remaining high as the stock was reduced to its historic lows and then declining to the low levels recorded during 1985-1990. The reduction in exploitation has resulted from both a decrease in the recorded landings and an increase in biomass following the better than average recruitment of the 1993-1995 year-classes. However, the assessment is considered to be very uncertain with respect to absolute estimates of stock size and it does not match the historic trends in the stock as illustrated by the longest survey series. Nevertheless, the trend in the recent years is believed to be reflective of the stock trajectory.

Mahe, J.C. and Bowering, W.R. 2002. An assessment of stock status of the Greenland halibut resource in NAFO Subarea 2 and Divisions 3KLMNO based on extended survivors analysis. NAFO SCR documents 02/78: 22 p.

An Extended Survivors Analysis was applied to the commercial catch at age data for Greenland Halibut in NAFO Subarea 2 and Divisions 3KLMNO from 1975-2001 to assess the current status of the stock. The analysis was calibrated using Canadian and European Union research vessel survey data. Stock biomass at ages 5 and older is estimated to have increased during the late 1980s and then declined rapidly during the period of high landings in the early 1990s. Estimated fishing mortality has followed the trend in landings, increasing rapidly in the early 1990s, remaining high as the stock was reduced to its historic lows and then declining to the low levels recorded during 1985-1990. The reduction in exploitation has resulted from both a decrease in the recorded landings and an increase in biomass following the better than average recruitment of the 1993-1995 year-classes. However, the assessment is considered to be very uncertain with respect to absolute estimates of stock size and it does not match the historic trends in the stock as illustrated by the longest survey series. The increasing trend in the late 1990s is believed to be reflective of the stock trajectory during that period, however, the continued increasing trend since then is inconsistent with the trends in stock size from all other major sources. Given these concerns, the assessment in its present form therefore is considered unreliable for projecting future stock trends and potential catch levels.

Mahe, J.C. and Briand, D. 1999. French research report for 1998. NAFO SCS documents 99/15: 7 p.

Mahe, J.C. and Briand, D. 2000. French research report for 1999. NAFO SCS documents 00/19: 7 p.

Mahe, J.C. and Briand, D. 2001. French research report for 2000. NAFO SCS documents 01/22: 2 p.

Mahe, J.C. and Darby, C. 2000. Greenland halibut in NAFO Subarea 2 and Divisions 3KLMNO, short-term and medium-term projections from an extended survivor analysis. NAFO SCR documents 00/54: 19 p.

In order to provide some information for short- and medium-term management of the stock of Greenland halibut (*Reinhardtius hippoglossoides*) in NAFO subarea 2 and Divisions 3KLMNO, a catch projection associated with a risk analysis was performed on the basis of a status quo fishing level. The input data were taken from an extended survivor analysis. The results show that on the status quo assumption, catches are expected to increase until 2002, to stabilise until 2004 and then to decrease. The spawning stock biomass indicator is expected to increase until 2005 and then to decrease.

Mathias, J. and Keast, M. 1996. Status of the Greenland halibut (*Reinhardtius hippoglossoides*) fishery in Cumberland Sound, Baffin Island 1987-95. NAFO SCR documents 96/71: 20 p.

Since the mid 1980s, Baffin Island Inuit have sought access to marine commercial fishery opportunities for turbot, shrimp and scallops in the inshore marine areas and adjacent offshore areas of Hudson and Davis straits. Marine fisheries are an important supplement to the traditional Inuit fisheries for Arctic char and marine mammals. The 1993 Nunavut Land Claims Agreement stipulates that special consideration will be given by government to the principles of adjacency and economic dependence when allocating commercial fishing licenses in the adjacent offshore marine areas. A fishery for Greenland halibut, (*Reinhardtius hippoglossoides*) has developed in Cumberland Sound, starting in 1986. This report is an update on earlier status reports.

Mathias, J.A. and Treble, M.A. 1997. An exploratory fishery for Greenland halibut (*Reinhardtius hippoglossoides*) in Division 0A with otter trawl in 1996: analysis of data collected by observers. NAFO SCR documents 97/38: 11 p.

An exploratory fishery for Greenland halibut (*Reinhardtius hippoglossoides*) in NAFO Div. 0A was undertaken during September-October, 1996 by a commercial stern trawler. In 30 fishing days, 329 tonnes of Greenland halibut were caught in 122 sets. Fishing effort was distributed among 4 exploratory sub-zones within Div. 0A, and was directed at depths between 1,000 and 1300 metres. The average catch per unit of effort in 106 trawl nets analyzed was 0.603 tonnes per hour. Estimates of trawlable biomass of Greenland halibut ranged from 1.7 to 3.9 tonnes per square kilometre. The best conservative estimate of the total biomass which might lie within the 1,000-1,300m contour in the 4 exploratory sub-zones in Div. 0A is 21.1 thousand tonnes. The average length of Greenland halibut caught in Div. 0A was similar to those caught by trawl in the Baffin inshore fishery, and larger than those caught further south. The discard rate of Greenland halibut was about 5% and the by-catch of other species was insignificant.

McConnaughey, R.A. 1995. Changes in geographic dispersion of eastern Bering Sea flatfish associated with changes in population size. *In* Proceedings of the International Symposium on North Pacific Flatfish, October 26-28, 1994, Anchorage Alaska. pp. 385-

405.

Trawl survey estimates of flatfish abundance in the eastern Bering Sea were used to evaluate the relationship between population size and spatial dispersion of populations. According to MacCall's "basin" hypothesis, fish may utilize suboptimal habitats in response to density-dependent interactions. Not only are there potential negative effects on individual fitness, but a relationship between stock area and abundance also influences catchability and could thus confound the resource assessments. Numbers of arrowtooth flounder (*Atheresthes stomias*), Greenland turbot (*Reinhardtius hippoglossoides*), yellowfin sole (*Pleuronectes asper*), rock sole (*Pleuronectes bilineatus*), Alaska plaice (*Pleuronectes quadrituberculatus*) and flathead sole (*Hippoglossoides elassodon*) were estimated using standard stratified sampling procedures. These estimates were compared with an index of dispersion based on the catch per unit effort-weighted average distance of a population from its calculated center of abundance during each year (1982-1993). Annual maps were examined and linear regressions were performed to evaluate the nature of the abundance-dispersion relationship for each species.

McConnaughey, R.A. and Smith, K.R. 2000. Associations between flatfish abundance and surficial sediments in the eastern Bering Sea. Can. J. Fish. Aquat. Sci. 57: 2410-2419.

Spatially explicit relationships between pleuronectid flatfish abundance and surficial sediments in the eastern Bering Sea were investigated using published sediment descriptions and trawl survey data (1982-1994). Flatfish food habits were also examined because sediment properties are known to affect the distribution and abundance of benthic prey. For six species, we compared sediment textures in areas of highest and lowest abundance (kilograms per hectare). Sand predominated in areas of high yellowfin sole (*Pleuronectes asper*) (YFS) (p mchlt 0.001) and rock sole (*Lepidopsetta* spp.) (RS) (p mchlt 0.001) abundance, while mixed sand and mud was most common in areas of lowest abundance. In contrast, mixed sand and mud predominated in areas preferred by flathead sole (*Hippoglossoides elassodon*) (FHS) (p mchlt 0.001), Alaska plaice (*Pleuronectes quadrituberculatus*) (AP) ($p = 0.002$), and arrowtooth flounder (*Atheresthes stomias*) (ATF) ($p = 0.004$), with more diverse substrates in low-density areas. Areas of high and low Greenland turbot (*Reinhardtius hippoglossoides*) (GT) ($p = 0.845$) abundance had similar sediment textures (primarily mixed sand and mud). Species with highly restricted diets (AP) or piscivores with weak sediment associations (GT, ATF) had relatively inflexible food habits, whereas YFS, RS, and FHS food habits varied considerably with sediment type. Our findings suggest that benthic-feeding pleuronectids prefer certain sediment textures because of adaptive differences in prey availability.

Mehl, S. 1996. Botnfiskundersokingar i Barentshavet vinteren 1996 [Investigations on demersal fish in the Barents Sea, winter 1996]. Fisken og Havet; 1996. 11: 68 p.
[In Norwegian, English summary]

A combined acoustic and bottom trawl survey to obtain indices of abundance and estimated of length and weight at age has been carried out each winter since 1981 in the Barents Sea. The target species are cod and haddock, but in recent years abundance indices have also been worked out for the redfish species and Greenland halibut. Since 1993 the survey area has been extended to the north and east in order to obtain a more complete coverage of the younger age groups of cod.

Mehl, S. 1996. Bunnfiskundersokelser i Barentshavet sommeren 1995 [Investigations on demersal fish in the Barents Sea summer 1995]. Fisken og Havet; 1996. 30: 33 p.
[In Norwegian, English summary]

The report presents the results from the first in a series of surveys which the Institute of

Marine Research has initiated in order to monitor the stocks of demersal fish in the Barents Sea area. The survey was conducted in August 1995 with 2 research vessels and 3 hired trawlers. Estimates of abundance were worked out on the basis of acoustic observations as well as from swept area calculations. The results from the present survey are compared both with winter surveys and with the combined results from annual surveys in the Svalbard region and from 0-group surveys for the years when significant bottom trawl sampling were made (1990-1993).

Mehl, S. 1997. Botnfiskundersokingar i Barentshavet (Norsk sone) vinteren 1997 [Investigations on demersal fish in the Norwegian Sea (Norwegian EEZ) winter 1997] Fisken og havet; 1997. 11: 72 p.
[In Norwegian, English summary]

A combined acoustic and bottom trawl survey to obtain indices of abundance and estimates of length and weight at age has been carried out each winter (4-6 weeks in January-March) since 1981 in the Barents Sea. The target species are cod and haddock, but in recent years abundance indices have also been worked out for the redfish species and Greenland halibut. Since 1993 the survey area has been extended to the north and east in order to obtain a more complete coverage of the younger age groups of cod. In winter 1997 only the Norwegian part of the Barents Sea was covered.

Mehl, S. 1998. Botnfiskundersokingar i Barentshavet (redusert omrade) vinteren 1998 [Investigations on demersal fish in the Barents Sea (reduced area) winter 1998] Fisken og Havet; 1998. 7: 69 p.
[Iin Norwegian, English summary]

A combined acoustic and bottom trawl survey to obtain indices of abundance and estimates of length and weight at age has been carried out each winter (4-6 weeks in January- Marth) since 1981 in the Barents Sea. The target species are cod and haddock, but in recent years abundance indices have also been worked out for the redfish species and Greenland halibut. Since 1993 the survey area has been extended to the north and east in order to obtain a more complete coverage of the younger age groups of cod. In winter 1997 only the Norwegian part of the Barents Sea was covered, while in 1998 also a small part of the Russian EEZ was included in the investigations.

Mehl, S. 1999. Botnfiskundersoekingar i Barentshavet vinteren 1999 : Detaljert rapport [Investigations on demersal fish in the Barents Sea winter 1999 : detailed report] Fisken og havet; 1999. 13: 70 p.
[In Norwegian, English summary]

A combined acoustic and bottom trawl survey to obtain indices of abundance and estimates of length and weight at age has been carried out each winter (4-6 weeks in January- March) since 1981 in the Barents Sea. The target species are cod and haddock, but in recent years abundance indices have also been worked out for the redfish species and Greenland halibut. Since 1993 the survey area has been extended to the north and east in order to obtain a more complete coverage of the younger age groups of cod. In winter 1997 only the Norwegian part of the Barents Sea and a small part of the Svalbard area was covered, while in 1998 also a small part of the Russian EEZ was covered. In 1999 the vessels had full access to the Russian EEZ. The main results in 1999 were: - the 1998 yearclass of cod is weak and the 1997 yearclass is below average, - the abundance indices of 3-5 year old cod (1996-1994 yearclasses) are now at an average level in the time series, - the numbers of 6 year and older cod are very low, - length and weight at age and weight increment are low but improving, - the 1998 yearclass of haddock is strong, - the abundance indices of older haddock is below average and partly very poor, - length and weight at age and weight increment are improving well, - the abundance indices of the redfish species are among the lowest in the time series and there are no signs of improved recruitment, - the total abundance index of Greenland halibut was strongly reduced from 1998 to 1999 and is among the lowest obtained since 1990. There are some weak signs of new recruitment.

Mehl, S. and Nakken, O.1994. Bunnfiskundersokelser i Barentshavet vinteren 1994 [Investigations on demersal fish in the Barents Sea winter 1994]. Fisken og Havet: 1994. 6: 72 p.
[In Norwegian, English summary]

A combined acoustic and bottom trawl survey aiming at obtaining indices of abundance and estimates of length and weight at age has been carried out each winter since 1981 in the Barents Sea. The target species are cod and haddock but in recent years abundance indices have also been worked out for the redfish species and Greenland halibut. Since 1993 the survey area has been extended to the north and east in order to obtain a more complete coverage of the younger age groups (age 1-3 years) pof cod and haddock than in previous years.

Mel'yantsev, R.V. and Nizovtsev, G.P. 1984. An unusual color in a Greenland halibut, *Reinhardtius hippoglossoides* (Pleuronectidae), from the Barents Sea. J. Ichthyol. 24: 152-153.
[Translated from Russian, Neobychnaya okraska chernogo paltusa *Reinhardtius hippoglossoides* (Walb.) (Pleuronectidae) v. Barentsovom more IN: Vopr. Ikhtiol. 24 (5): 865-866]

A description is given of a female specimen of Greenland halibut, *Reinhardtius hippoglossoides*, round on the western slope of Madvezhinsk Bank, on 22 October 1981, which shows an unusual rose colour. The species is thought to be the result of a single mutation, disturbing the synthesis of melanin, which determines the colour of this species.

Mel'yantsev, R.V. and Nizovtsev, G.P. 1984. Neobychnaya okraska chernogo paltusa *Reinhardtius hippoglossoides* (Walb.) (Pleuronectidae) v Barentsovom more [Peculiar coloration of Greenland halibut *Reinhardtius hippoglossoides* (Walb.) (Pleuronectidae) in the Barents Sea]. Vopr. Ikhtiol. 24: 865-866.
[In Russian]

The paper reports on a pinky-coloured female Greenland halibut *R. hippoglassoides* caught at a depth of 600-640 m, at 76 degree 01'N and 14 degree 09'E in October 1981. The unique coloration is believed to be due to a mutation which resulted in the disturbance of melanin synthesis.

Melindy, S. and Flight, J. 1993. Development of a deep water turbot fishery in inshore gillnetters, 1992. Canada/Newfoundland Inshore Fisheries Development Agreement. Underutilized Species Program, St. John's, Newfoundland.

In 1992, fishing effort, fishing depths, catches and other parameters for 22 inshore gillnet vessels (LOA 55-65') directing for turbot (*Reinhardtius hippoglossoides*) in deep waterwere monitored. The data were analyzed to identify catch rates, average fish size, by-catch quantities, mesh size versus size of fish caught and other gear versus catch relationships. Approximately six million pounds of turbot (Greenland Halibut) were harvested in NAFO Divisions 2J3KL. The catch and catch rates are defined by gillnet soak time, fishing area, and water depth. Sample measurement for length, weight, male:female ratio as well as quality assessments of handling practices on turbot, and catch comparisons for a variety of experiments on gillnet modifications were conducted during the season.

Mercer, K.M. and Randell, F. 1976. Exploratory gillnet fishing for turbot in Tooker Bank area. Canada. Dept. of Fisheries and Oceans. Development Branch, St. John's, Newfoundland.

Up until 1968 this species, *(Reinhardtius hippoglossoides*), was commonly known as Greenland halibut; however, protest by U.S. fishermen of the marketing of this fish under that name has resulted in this fish being now exported as Newfoundland turbot or Greenland turbot. Since the 1950s limited quantities of turbot have been taken by Newfoundland fishermen along the north and north-east coasts first by trawl lines and later by gillnets. The catch has generally been accidental and taken while fishing for other species.

Messtorf, J. and Wagner, G. 1980. Fischereiforschung im Nordatlantik mit FMS "Karlsburg " vom 28 August bis 27 Oktober 1980 [Fishing research in the North Atlantic With FMV Karlsburg From 28th August to 27th October 1980]. Inf. Fischwirtsch. 27: 219-227.
[In German]

Statistical data was collected for stock assessment of pelagic fish in the North Atlantic. Preliminary data on geographical distribution, population density, weight and length of *Micromesistius poutassou, Mallotus villosus, Reinhardtius hippoglossoides, Macrourus berglax, Coryphrenoides rupestris, Gadus morhua, Sebastes marinus* and *Sebastes mentella* are given.

Metuzals, K.I. 1980. Flatfish 4VWX update of the status in 1979 of : American plaice, yellowtail flounder, witch flounder, winter flounder, Atlantic halibut and Greenland halibut. CAFSAC Res. Doc. 80/36: 21 p.

Metuzals, K.I. 1985. Biological stock update (for 1984) for American plaice in NAFO Division 4T. CAFSAC Res. Doc. 85/88: 27 p.

Meyboom, P. 1988. Canadian request for scientific advice on management in 1989 of certain stocks in Subareas 0 to 4. NAFO SCS documents 88/03: 1 p.

Meyboom, P. 1989. Canadian request for scientific advice on management in 1989 of certain stocks in Subareas 0 to 4. NAFO SCS documents 89/01: 1 p.

Meyboom, P. 1990. Canadian request for scientific advice in management in 1991 of certain stocks in Subareas 0 to 4. NAFO SCS documents 90/03: 1 p.

Mezhnin, F.I. 1979. Interrenal and suprarenal glands of bony fishes. Izvestiya Akademii Nauk SSR Seriya Biologicheskaya 4: 512-519.
[In Russian]

Topography and histology of the 2 endocrine glands of bony fishes were studied. Seventeen species [*Gadus morhua morhua, Melanogrammus aeglepfinus, G. virens, Macrurus berglax, Anarhichas minor, A. latifrons, A. lupus, Leptochinus malulatus, Lycodes vahli, L. esmarki, Sebastes marinus, Myoxocephalus quadricornis, Agonus cataphractus, Liparis liparis, Reinhardtius hippoglossoides, Hippoglossoides hippoglossoides* and *Platessa platessa*] of sea fishes of 10 families were investigated. The structure and localization of interrenal and chromaffin tissues of the sea fishes were not similar. The differences in topography and histology of the tissues as well as in quantity were obtained for limnetic and sea forms.

Michalsen, K. and Nedreaas, K.H. 1998. Food and feeding of Greenland halibut (*Reinhardtius hippoglossoides* Walbaum) in the Barents Sea and East Greenland waters. Sarsia 83: 401-407.

This report describes the diet of Greenland halibut (*Reinhardtius hippoglossoides*, Walbaum) on the continental slope in the western Barents Sea (1992-1994) and on the shelf outside East Greenland 1991). The proportion of empty stomachs was high: for many predator length groups more than 80%. There was a decreasing percentage of empty stomachs with increasing predator length. Cephalopods, and especially *Gonatus fabricii*, was the most important prey category for Greenland halibut at East Greenland in 1991 as well as in the Barents Sea in 1992 and 1994. In the Barents Sea in 1993, however, indeterminable fish remains and herring were the most important prey categories. Herring and blue whiting were the most important species of fish prey in the Barents Sea. It was impossible to identify the fish remains at East Greenland. The potential of stomach data in further ecological investigations and management of Greenland halibut is discussed.

Mikawa, M. 1969. Ecology of the lesser halibut, *Reinhardtius hippoglossoides* Matsuurae Jordan and Snyder. Can. Transl. Fish. Aquat. Sci. 1260: 106 p.
[Translated from Japanese "Karasugarei no seitai" IN: Tohoku - Kaiku Suisan Kenkyusho Kenkyu Hokoku (23): 1-41, 1963]

The present paper describes the ecology of various subspecies of the Greenland halibut in the wide sea-region centering around the Cape Erimo of Hokkaido. Also, it presents some morphological and ecological comparisons between the subspecies in the same sea-region.

Milinskii, G.I. 1968. The biology and fisheries of Greenland halibut of the Barents Sea. Can. Transl. Fish. Aquat. Sci. 1159: 22 p.
[Translated from Russian "Materialy po biologii i promyslu chernogo paltusa Barentsova Morya"; original appeared in Trudy Polyarnogo Nauchno-Issledovatel'skogo i proektnogo Instituta Morskogo Rybnogo Khozyaistva i Okeanografii im. N.M. Knipovicha (PINRO). 8: 375-386, 1944]

Minet, J.P. 1974. Donnees sur la biologie de la plie americaine *Hippoglossoides platessoides* des bancs meridionaux de Terr-Neuve et du plateau du Cap Breton [Data on the biology of the American plaice, *Hippoglossoides platessoides*, from the meridional banks of Newfoundland and from the Cape Breton shelf]. Rev. Trav. Inst. Pêches Marit. Nantes 38: 347-434.
[In French]

The work described here shows that there are no significant differences at the morphological level between the 2 shoals of plaice on both sides of the Lawrence channel, although the environmental conditions are not identical. There is uniformity in the morphological characteristics. There are biological and physiological differences particularly in the alimentary region, in the rate of growth, in egg laying and in sexual maturity. These differences explain the 2 different units of stock. The data obtained for male and female are treated separately. The results provide a description of a sampling technique and a system which will be useful as a basis for study of the dynamics of the stocks and for an estimation of their numbers for reasonable exploitation.

Minet, J.P., Forest, A., and Perodou, J.B. 1978. Biological data on the northern deepwater prawn, *Pandalus borealis*, off Baffin Island. Int. Comm. Northwest Atl. Fish. Sel. Pap. 21.

In the autumn of 1977, significant catches of the northern deepwater pawn, *P. borealis* were taken in a groundfish trawl survey by the research vessel Cryos in Statistical Area O. A minimum estimate of the biomass based on the area swept with the groundfish trawl, which is inefficient for shrimp, is about 4,000 metric tons. Modes of 12 . 9, 17 . 9, 23 . 1 and 29 . 5 mm in the length frequencies are considered to represent age-groups 2, 3, 4 and 5+, Greenland halibut, *Reinhardtius hippoglossoides*, and redfish, *Sebastes marinus mentella*, dominated the by-catches.

Misra, R.K. and Bowering, W.R. 1984. Stock delineation of Greenland halibut in the Northwest Atlantic using a recently developed multivariate statistical analysis based onmeristic characters. N. Am. J. Fish. Manage. 4: 390-398.

Meristic characters of Greenland halibut (*Reinhardtius hippoglossoides)* from 8 areas of the Canadian Northwest Atlantic were examined. Using a recently developed multivariate analysis technique, the meristics were analyzed to determine the accurate delineation of Greenland halibut stocks throughout the area investigated. At least 2 separate populations of Greenland are indicated in the Canadian Northwest Atlantic. These are found in the Gulf of St. Lawerence and from Davis Strait at West Greenland to the northern Grand Bank. There is some evidence of localized spawning stocks in Fortune Bay, Newfoundland and the Labrador area. Based on this analysis, the results tend to agree with those other independent techniques for stock separation of Greenland halibut.

Missios, P.C. and Plourde, C. 1996. The Canada-European Union turbot war: a brief game theoretic analysis. Canadian Public Policy 22: 144-150.

This paper examines the conflict over catch quotas for turbot on the Grand Banks of Newfoundland between the European Union (EU) and Canada. Economic game theory is used to analyse Canadian policy, EU policy, and the ensuing resolution. Recommendations are provided for future agreements regarding the proper management of fish stocks to ensure the long-term viability of these resources.

Moeller, S. and Schultz, H. 1980. German Democratic Republic research report for 1979. NAFO SCS documents 80/VI/19: 7 p.

Mombeck, F. 1981. Untersuchung der Grundfischbestaende vor Labrador [Assessment of bottom stocks off Labrador). Inf. Fischwirtsch. 28: 4-9.
[In German]

Stocks were assessed from 68 half-hour bottom trawls by FRV Anton dohrn using the stratified random sampling method. From the 68 trawls a total of 24,988 kg were caught. This was comprised of 28% cod, 30% sea bream, 15% dab, 10% catfish, 10% Greenland halibut, 4% grenadier and 3% others. Depth of catch, length distribution, and water temperature/catch data are given.

Mombeck, F. 1983. Untersuchung der Grundfischbestaende vor Labrador [Investigation of benthic fish stocks near Labrador]. Inf. Fischwirtsch. 30: 9-15.
[In German]

The benthic fish stocks near Labrador had been systematically investigated by standard hauls in four depths from October to November 1982. The vertical distribution and length frequencies in the catches are described for *Gadus morhua, Sebastes mentella, Lycodes reticulatus, Lycodes vahlii, Reinhardtius hippoglossoides, Hippoglossoides platessoides, Macrourus berglax* and catfish.

Moore, J.A. and Galbraith, J.K. 1998. Results of exploratory fishing off the northeastern United States. ICES CM 1998/O:44: 9 p.

From 1995 to 1997, exploratory deep-sea fishing was conducted along the continental slope, in canyons, and on certain seamounts by a few commercial fishers from New England. Most fishing occurred from the vicinity of Hudson Canyon to northeastern Georges Bank, and between depths of 310 and 1850 m. This fishing effort, and other recent research, have produced new findings concerning the composition of slope and seamount fish faunas within this area, including the addition of 80 species new to the area. This corresponds to roughly a 15 % increase in the total number of deep-sea pelagic and demersal species known off New England. Preliminary information is also provided on the catches and potential viability of commercial deep-sea fisheries in the region. A precautionary approach is recommended in the further development of deepwater fisheries.

Moore, J.A. and Gordon, J.D.M. 2003. Symposium on deep-sea fisheries: NAFO/ICES/CSIRO Symposium 12-14 September 2001. J. Northwest Atl. Fish. Sci. 31.

This symposium considered current research, advances and impacts of deep-water fisheries in many different locations around the world. The six sessions held were: 1) Session 1: Deepwater Fisheries (Part 1) 2) Session 2: Greenland Halibut 3) Session 3: Deepwater Fisheries (Part 2): Impacts Assessment and Management 4) Session 4: Biology and Life History 5) Session 5: Redfish 6) Session 6: Fisheries Ecology

Morgan, J., Burnett, J., and Aro, E. 1999. Variations in maturation, growth, condition and spawning stock biomass production in groundfish. J. Northwest Atl. Fish. Sci. 25: 248 p.

Changes in maturation, growth and condition, duration of the spawning season and the spatial distribution of the spawning stock have been observed in several groundfish stocks, particularly in the North Atlantic. These variations have direct implications for spawner biomass production per recruit and management strategies that incorporate these parameters. The purpose of this Symposium was to discuss the causes and consequences of such variations, including evidence of environmental, density-dependent, predation or size-selective fishing effects and consequences for spawner biomass per recruit and population growth rate, as well as implications for management strategies.

Morgan, M.J. and Bowering, W.R. 1995. Maturity at size and age of Greenland halibut in NAFO Subarea 2 and Divisions 3KLM. NAFO SCR documents 95/54: 19 p.

Maturity at size and age of Greenland halibut *Reinhardtius hippoglossoides* in NAFO Subarea 2, and Div. 3K, 3L and 3M was investigated using three separate data sources. Proportions mature at length showed large spatial and temporal variability from all sources of data. There were no apparent trends in this variability, which may be a result of irregularities in the maturation process and spawning of Greenland halibut and/or variability in the distribution of mature fish.

Morgan, M.J. and Bowering, W.R. 1997. Temporal and geographic variation in maturity at length and age of Greenland halibut (*Reinhardtius hippoglossoides*) from the Canadian north-west Atlantic with implications for fisheries management. ICES J. Mar. Sci. 54: 875-885.

Maturity at size and age of Greenland halibut in the Canadian north-west Atlantic were investigated using three separate data sources: (1) Canadian fall research vessel surveys from 1978 to 1994 in NAFO Div. 2J and 3K; (2) Canadian deep water surveys in NAFO Div. 3K, 3L and 3M in 1991, 1994 and 1995; and (3) Canadian commercial deep water gillnet fishery in 1993 and 1994 in Div. 0B, 2G, 2H, 3K and 3L. Estimated proportion of fish mature in each length group showed large spatial and temporal variability from all data sources. Proportions mature at age (only available from the Canadian deepwater surveys) also exhibited inconsistency with the age at 50% maturity ranging from 9.5 to 15.0 years for females and from 8.2 to 11.6 for males. There were no apparent trends in this variation, which may be a result of irregularities in the maturation process and spawning of Greenland halibut, leading to variability in the distribution of adult fish. The inavailability of precise estimates of maturity at age and size will make the measurement of the effect of fishing practices on spawning stock biomass and yield per recruit and/or advice on minimum fish size to protect juveniles extremely difficult. A synoptic survey of the entire stock area may be the only way to obtain an accurate reflection of the maturity schedule of the population.

Morgan, M.J. and Bowering, W.R. 1999. Estimates of maturity of Greenland halibut from 'synoptic' surveys. NAFO SCR documents 99/9 : 11 p.

Studies on the maturation and spawning of Greenland halibut, (*Reinhardtius hippoglossoides*) have revealed a great deal of variability. This suggests that a synoptic survey of the entire stock area might provide a better estimate of the maturity pattern in Greenland halibut. In the fall of 1996-98, the Canadian Department of Fisheries and Oceans conducted synoptic surveys covering the stock area from Div. 2GH in the north to Div. 3NO in the south. This study analyses the maturity data collected during these surveys and compares it to previous information to determine if a synoptic survey does in fact decrease the variability in estimates of maturity at size for Greenland halibut. The authors believe that average maturity ogives weighted by divisional population size from the synoptic survey represent the best possible estimates of Greenland halibut maturity rates in SA2+Div. 3KLMNO. If the variation between years observed in this study is considered to be a reasonable expectation for a species which experiences highly peculiar maturity and spawning cycles, then applying annual ogives to determine SSB should be acceptable. There are few empirical data for the entire stock area to determine the historic SSB. given the lack of trend in the Div. 2J, 3K data, applying an average from the last 3 synoptic survey years to the historic time series may not be unreasonable. As more synoptic data accumulate a re-evaluation of the approach may be warranted.

Morgan, M.J. and Bowering, W.R. 1999. Temporal and geographic variation in maturity at length and age of Greenland halibut (*Reinhardtius hippoglossoides*) from the Canadian north-west Atlantic with implications for fisheries management. *In* Ecology, fisheries and management of Greenland halibut (*Reinhardtius hippoglossoides* (Walbaum)) in the Canadian Northwest Atlantic. *Edited by* W.R.Bowering. Thesis (Ph.D.) University of Bergen, Bergen (Norway). 10 p.

Maturity at size and age of Greenland halibut in the Canadian north-west Atlantic were investigated using three separate data sources: (1) Canadian fall research vessel surveys from 1978 to 1994 in NAFO Div. 2J and 3K; (2) Canadian deep water surveys in NAFO Div. 3K. 3L and 3M in 1991, 1994 and 1995; and (3) Canadian commercial deep water gillnet fishery in 1993 and 1994 in Div. 0B, 2G, 2H, 3K and 3L. Estimated proportion of fish mature in each length group showed large spatial and temporal variability from all data sources. Proportions mature at age (only available from the Canadian deepwater surveys) also exhibited inconsistency with the age at 50% maturity ranging from 9.5 to 15.0 years for females and from 8.2 to 11.6 for males. There were no apparent trends in this variation, which may be a result of irregularities in the maturation process and spawning of Greenland halibut, leading to variability in the distribution of adult fish. The inavailability of precise estimates of maturity at age and size will make the measurement of the effect of fishing practices on spawning stock biomass and yield per recruit and/or advice on minimum fish size to protect juveniles extremely difficult. A synoptic survey of the entire stock area may be the only way to obtain an accurate reflection of the maturity schedule of the population.

Morgan, M.J. and Bowering, W.R. 2000. Maturity at age and size of Greenland halibut (*Reinhardtius hippoglossoides*) and geographic distribution of spawning fish. NAFO SCR documents 00/6: 15 p.

Maturity at size and age of Greenland halibut (*Reinhardtius hippoglossoides*) were investigated using survey information. Maturity at size is highly variable when examined on a Divisional basis. Estimates are much less variable when examined over the entire Subarea 2 and Div. 3 KLMNO area. During the 1996-1999 period using data from the entire area, estimates of length at 50% maturity for males have varied from 57 to 61 cm and for females from 74 to 82 cm. Estimates for age at 50% maturity have varied from 9 to 10 years for males and from 12 to 13 years for females. The distribution of spawning fish was also investigated using survey and commercial fishery data. Some spawning fish were found in all areas. This raises the possibility that a number of spawning components exist and heightens the concern about the distribution of commercial catch relative to the distribution of biomass, as spawning components could be eliminated by excessive catch in an area.

Morgan, M.J. and Bowering, W.R. 2001. Further comparisons of estimates of maturity for Greenland halibut from surveys covering different portions of the stock area. NAFO SCR documents 01/49: 10 p.

Maturity at age and size were examined for male and female Greenland halibut (*Reinhardtius hippoglossoides*). Estimates were produced for a portion of the stock area (Div. 2J3K) from 1978-2000 and from 'synoptic' surveys covering the stock area from Div. 2GH in the north to 3NO in the south from 1996-1999. The estimates from the Div. 2J3K area were similar to those from the wider area but were extremely variable, particularly since the late 1980s. This variability limits their usefulness for the production of spawning stock biomass. However, there was no apparent trend over time in the estimates for the Div. 2J3K area and the best estimates for the entire time period may be those produced from the synoptic surveys of 1996-1999. Estimated age at 50% maturity for females from these surveys is 13.6 years.

Morgan, M.J., Bowering, W.R., and Brodie, W.B. 1994. A comparison of results from Canadian deepwater surveys in 1991 and 1994, with emphasis on Greenland halibut. NAFO SCR documents 94/53: 18 p.

With the development of fisheries in the deep water in the NAFO regulatory area in Div. 3KLMN, it was decided to conduct research vessel surveys in this area to learn more about the distribution and abundance of several species, particularly Greenland halibut (*Reinhardtius hippoglossoides*) and to monitor changes in the populations over time. Two surveys was conducted, one by the Cape Adair in summer 1991 and the other by the Zandvoort in winter 1994. This paper compares the results of these two surveys with special emphasis on Greenland halibut.

Morgan, M.J., Bowering, W.R., Gundersen, A.C., Høines, Å., Morin, B., Smirnov, O., and Hjörleifsson, E. 2001. Comparative analyses of Greenland halibut (*Reinhardtius hippoglossoides*) maturation for populations throughout the North Atlantic. NAFO SCR documents 01/116: 13 p.

The maturation of four populations of Greenland halibut (*Reinhardtius hippoglossoides*) was examined: Gulf of St. Lawrence, Labrador-eastern Newfoundland, East Greenland-Iceland-Faroe Islands and the Northeast Arctic (Svalbard and Barents Sea). The maturity schedules were compared among these populations as well as the variability in the data across the different populations. Estimates of size and age at 50% maturity were very similar except that the fish in the Labrador-eastern Newfoundland area appeared to mature at a larger size and older age. All data sets showed substantial variability with data from the Gulf of St. Lawrence during the 1996 to 2000 period being perhaps the least variable. When data collected over the entire distribution area were compared to data collected from portions of population distribution variablity was found to be substantially less.

Morgan, M.J., Bowering, W.R., Gundersen, A.C., Høines, Å., Morin, B., Smirnov, O., and Hjörleifsson, E. 2003. A comparison of the maturation of Greenland halibut (*Reinhardtius hippoglossoides*) from populations throughout the North Atlantic. J. Northwest Atl. Fish. Sci. 31: 99-112.

The maturation of Greenland halibut (*Reinhardtius hippoglossoides*) was examined from data collected on four populations: Gulf of St. Lawrence, Labrador-eastern Newfoundland, east Greenland-Iceland-Faroe Islands and the Northeast Arctic (Svalbard and Barents Sea). The maturity schedules were compared among these populations as well as the variability in the data from the different data sets. Estimates of size and age at 50% maturity were very similar for the different data sets except that the fish in the NAFO Divisions 2J+3K portion of the Labrador-eastern Newfoundland area appeared to mature at a considerably larger size and older age. All data sets showed substantial variability with data from the Gulf of St. Lawrence during the 1996 to 2000 period being perhaps the least variable. When data collected over the entire distribution area were compared to data collected from portions of a population's distribution, there was substantially less variability.

Mori, J. and Kawahara, S. 1997. Japanese research report for 1996. NAFO SCS documents 97/8: 2 p.

Morin, B. 1996. Flétan du Groenland du golfe du Saint-Laurent (4RST). MPO Pêches de l'Atlantique rapport sur l'état des stocks 95/58F, 7 p.
[In French]

Morin, B. 1996. Greenland halibut in Gulf of St. Lawrence (4RST). DFO Atlantic fisheries stock status report 96/58, 7 p.

Morin, B. 1997. Flétan du Groenland du golfe du Saint-Laurent (4RST). MPO Sciences rapport sur l'état des stocks A4 03: 7 p.
[In French]

Morin, B. 1997. Greenland halibut in the Gulf of St. Lawrence (4RST). DFO Science stock status report A4 03: 6 p.

Morin, B. 1999. Flétan du Groenland du golfe du Saint-Laurent (4RST). MPO Sciences rapport sur l'état des stocks A4 03 (1999): 8 p.
[In French]

Morin, B. 1999. Gulf of St. Lawrence (4RST) Greenland halibut. DFO Science stock status report A4 03 (1999): 7 p.

Morin, B. 2000. Flétan du Groenland du golfe du Saint-Laurent (4RST). MPO Sciences rapport sur l'état des stocks A4 03 (2000): 8 p.
[In French]

Morin, B. 2000. Gulf of St. Lawrence (4RST) Greenland halibut. DFO Science stock status report A4 03 (2000): 7 p.

Morin, B. 2001. Flétan du Groenland du golfe du Saint-Laurent (4RST). MPO Sciences rapport sur l'état des stocks A4 03 (2001): 9 p.
[In French]

Morin, B. 2001. Gulf of St. Lawrence (4RST) Greenland halibut. DFO Science stock status report A4 03 (2001): 8 p.

Morin, B. 2002. Flétan du Groenland du golfe du Saint-Laurent (4RST) en 2001. MPO Sciences rapport sur l'état des stocks A4 03 (2002): 12 p.
[In French]

Morin, B. 2002. Gulf of St. Lawrence (4RST) Greenland halibut in 2001. DFO Science stock status report A4 03 (2001): 11 p.

Morin, B. 2003. Flétan du Groenland du golfe du Saint-Laurent (4RST) en 2002. Rapport sur l'état des stocks 2003/007: 14 p.
[In French]

Morin, B. 2003. Gulf of St. Lawrence (4RST) Greenland halibut in 2002. Stock status report 2003/007: 13 p.

Morin, B. 2004. Flétan du Groenland du golfe du Saint-Laurent (4RST) en 2003. Rapport sur l'état des stocks 2004/014: 11 p.
[In French]

Morin, B. 2004. Gulf of St. Lawrence (4RST) Greenland halibut in 2003. Stock status report 2004/014: 10 p.

Morin, B. and Bernier, B. 1993. Le flétan du Groenland (*Reinhardtius hippoglossoides*) du golfe du Saint-Laurent (4RST): La pêche en 1992 et l'état du stock = Greenland halibut (Reinhardtius hippoglossoides) of the Gulf of St. Lawrence (4RST): The fishery in 1992 and the state of the stock. DFO Atlantic fisheries research document; 93/41.
[Text in English and French in parallel columns]

Since 1988, landings of Greenland halibut from 4RST have declined sharply to 2,200 t in 1991, and increased again to 3,400 t in 1992. The fishing gear most used in this fishery since the mid-1970s is the gill net. Most of the fish caught in 1992 were in the 41 to 45 cm range, corresponding to the 1985-86 year- classes. The catch rates for the Index Fishers Program were higher in 1992 than in 1991. The biomass estimates from the research surveys fell in 1988 and 1989, but increased again thereafter. Research survey results indicate that the 1988 year- class seems to be good; however, it will be impossible to estimate its size or compare it with the 1980-81 age groups, which sustained the fishery in 1986-88, before it begins contributing significantly to the fishery.

Morin, B. and Bernier, B. 1999. Assessment and biology of Greenland halibut (*Reinhardtius hippoglossoides*) in the Gulf of St. Lawrence (4RST) IN 1998 = Evaluation et biologie du flétan du Groenland (*Reinhardtius hippoglossoides*) du golfe du Saint-Laurent (4RST) EN 1998. Canadian Stock Assessment Secretariat research document 99/185, 57 p.
[Text in English and French in parallel columns]

The largest summer concentrations of Greenland halibut in the gulf of St. Lawrence are found in the west and north of Anticosti Island and near the west coast of Newfoundland in the Esquiman Channel. Gillnets have been the most widely used fishing gear since the mid-1970's. Preliminary landings for 1998 totalled 3,989 t, while total allowable catch (TAC) was 4,000 t. The CPUEs of gillnet fishers in 1998 rose by 25% over 1996 and 1997. The abundance indices for Greenland halibut show an increase in biomass since 1990 and an increase in commercial size fish since 1994. However, the biomass index and the abundance of adults in the DFO research survey declined slightly in 1998. Finally, a new very abundant year-class (1997) was observed in 1998 on the research survey. On the basis of histological criteria, the size at which 50% of females reach maturity was estimated at 46 cm in 1998.

Morin, B. and Bernier, B. 2003. Évaluation de flétan du Groenland (*Reinhardtius hippoglossoides)* du golfe du Saint-Laurent (4RST) en 2002 = Assessment of Greenland halibut (*Reinhardtius hippoglossoides*) in the Gulf of St. Lawrendce (4RST) in 2002. Canadian Stock Assessment Secretariat research document 2003/088: 72 p.
[Text in English and French in parallel columns]

The 2002 landings increased by 25% compared to 2001 levels, primarily because Newfoundland fishermen exceeded their allocation by around 100 T and because significant catches (275 T) were made during an experimental fishery in Quebec. Yet again, the total allowable catch (TAC) was not reached, despite a 1,000 tons reduction. The catch rates of gillnet fishermen rose in 2002, mainly in the Esquiman Channel. Landings consisted of females for the most part. As mean catch size has decreased since 1998, the number of Greenland halibut per landed ton grew of 30% between 1998 and 2002. A comparative fishing experiment conducted in Quebec in 2002 using 5.5-inch and 6-inch mesh showed a high proportion of females in landings (greater than 80%) with either mesh size. Mean catch sizes for the 5.5-inch and 6.0-inch mesh were 43 cm and 45 cm, respectively, while the proportions of immature females in landings made with 5.5-inch and 6-inch mesh were 62% and 42%, respectively. However, catch per unit effort (CPUE) was at least three times higher when using 5.5-inch mesh. Biomass indices from surveys increased between 1995 and 2000, but were down in 2001 and 2002. However, the 2002 DFO survey index was still higher than the 1990s index average. It should be noted that the DFO survey index was boosted by the large year-classes of 1997 and 1999. Survey indices show that abundance of fish of 44 cm and more (fish available to the fishery) has been declining since 1999. The individual growth rate of the large 1997 year-class was lower than that of the previous year-classes in the western Gulf, which means that it will take longer for the 1997 year-class to reach the commercial size. The lower growth rate was less marked in the Esquiman Channel, which explains why fishing was better there in 2002. However, in 2002, the feeding, condition and growth rate of juvenile Greenland halibut improved, and size at sexual maturity increased for males. Although the abundance of pre-recruits (1997 and 1999 year classes) is high, it is difficult to predict how successful the fishery will be in 2003 considering the weaker growth rate of the 1997 year-class.

Morin, B., Fréchet, A., Aparicio, M., Lefèbvre, L., and Bernier, B. 1992. Évaluation du stock de flétan du Groenland (*Reinhardtius hippoglossoides*) du golfe du Saint-Laurent. CAFSAC Res. Doc. 39 p.
[In French]

The status of Greenland Halibut in the Gulf of St. Lawrence has not been assessed for the last five years due to uncertainties regarding stock structure. Since 1988, landings have dropped to a low of 2,200 t in 1991. Gill net is the principal fishing gear used since the mid 1970s. The size of the fish caught in 1991 varied between 40 and 45 cm. Standardized catch rates from trawlers and biomass index from research vessel (RV) surveys are also decreasing since 1988. However, length frequencies and catch at age from RV surveys show that the 1987 to 1989 year classes seem abundant and this may be an indication of good recruitment to the fishery in 2 or 3 years. A TAC of 4,000 t was recommended by CAFSAC in 1993.

Morin, B., Bernier, B., and Bourassa, L. 1994. Le stock de flétan du Groenland (*Reinhardtius hippoglossoides*) du golfe du Saint-Laurent (4RST): état de la ressource en 1993. MPO document de recherche sur les pêches dans l'Atlantique 94/25: 31 p.
[In French]

Landings of Greenland halibut of 4RST have declined from 3,400 t to 2,800 t between 1992 and 1993. This drop is principally due to mobile gears, particularly in the shrimp fishery with the introduction of the Nordmore grid in 1993. The gear most used in this fishery since the mid-1970s has been the gillnets. Most of the fish caught in 1993 were in the 41 to 43 cm range, corresponding to the 1988 year-class. A large proportion of the catch was composed of immature fish. Preliminary analysis of the catch rates of index-fishers showed a decline between 1992 and 1993. Abundance index for the summer research survey showed an important decrease in 1993 in comparison with 1992 and also year-classes (1989-1991) weaker than the 1988 year-class. It will be important to reduce the fishing effort and the proportion of immature fish caught to insure the conservation of this resource in the Gulf of St. Lawrence.

Morin, B., Bernier, B., Chabot, D., and Maguire, J. J. 1995. Évaluation et biologie du flétan du Groenland (*Reinhardtius hippoglossoides*) du golfe du Saint-Laurent (4RST) en 1994. MPO Pêches de l'Atlantique rapport sur l'état des stocks 95/59, 47 p.
[In French]

Since 1992, Greenland halibut of Divisions 4RST is managed as a distinct population on the basis of yield per recruit. The main concentrations of Greenland halibut in the Gulf of St. Lawrence during the summer are found on the west side of Anticosti Island and to a lesser extent north of this Island and in the Esquiman channel near the west coast of Newfoundland. Preliminary results on sexual maturity of Greenland halibut in the estuary of the St. Lawrence River had showed that the length where 50% of the male and the female were mature were 39 and 56 cm respectively in 1993-94. Landings of 4RST Greenland halibut have increased from 2,800 t to 3,600 t between 1993 and 1994. Gillnet is the main fishing gear used in this fishery since the middle of the 1970's. The size of fish caught by gillnet in 1994 was mainly between 41-45 cm and 70% of these fishes were female. Thus, the majority of the catch were immature fish. Abundance indices showed that the biomass of Greenland halibut is low but relatively stable since 1990. Exploitation rate is probably high and the low number of large fish results in the concentration of this exploitation on the annual recruitment. Thus, it is important to protect juveniles in order to allow the spawning biomass to increase.

Morin, B., Bernier, B., Arthur, R., Chouinard, G., Fréchet, A., and Gagnon, P. 1996. L'évaluation et la biologie du flétan du Groenland (*Reinhardtius hippoglossoides*) du golfe du Saint-Laurent (4RST) en 1995 = Assessment and biology of Greenland halibut (*Reinhardtius hippoglossoides*) in the Gulf of St. Lawrence (4RST) in 1995. DFO Atlantic fisheries research document 96/53, 59 p.
[Text in English and French in parallel columns]

The main concentrations of Greenland halibut in the Gulf of St. Lawrence during the summer are found on the west side of Anticosti Island and to a lesser extent north of this Island and in the Esquiman Channel near the west coast of Newfoundland. Gillnet is the main fishing gear used in this fishery since the mid 1970's. Preliminary landings of 1995 reached 2300 t. The total allowable catch was fixed to 4000 t since 1993. In 1996, it was reduced to 2000 t. Abundance indices increase slightly since 1990. Also, the abundance of commercial sizes Greenland halibut has increased since 1994 because of the presence of good year-classes. However, large fish were still not numerous in the population in 1995 and the number of juveniles in 1995 was still lower than the average of 1990-1995. The length at which 50% of the females reach maturity was estimated at 49 cm in 1995. The weight of fish according to length increased slightly in 1995 for fish over 40 cm. In winter, the Greenland halibut concentrated in the Cabot Strait area are probably coming from the Gulf of St. Lawrence.

Morin, B., Bernier, B., and Albert, E. 1998. Assessment and biology of Greenland halibut (*Reinhardtius hippoglossoides*) in the Gulf of St. Lawrence (4RST) in 1996 and 1997 = Évaluation et biologie du flétan du Groenland (*Reinhardtius hippoglossoides*) du golfe du Saint-Laurent (4RST) en 1996 et 1997. Canadian Stock Assessment Secretariat research document (98/07): 57 p.

[Text in English and French in parallel columns]

The main Greenland halibut concentrations in the Gulf of St. Lawrence during the summer are found west of Anticosti Island and, to a lesser extent, north of this Island and in the Esquiman channel, near the west coast of Newfoundland. Gillnets are the main gear type used in this fishery since the mid-1970s. The 1997 preliminary landings totalled 2459 t. The total allowable catch (TAC) was set at 3000 t in 1997. On the whole, the CPUEs of index fishermen were twice as high in 1996 and 1997 as during the period 1991 to 1995. Abundance indices for Greenland halibut have risen since 1990, with a more pronounced increase since 1994. The abundance of commercial-size individuals has increased since 1994 owing to the presence of strong year-classes. In 1996 and 1997, the number of juveniles rose significantly. In addition, the length at which 50% of females reach maturity was estimated at 50cm during this period. Preliminary results from microscopic analyses of ovaries have revealed evidence of maturation that cannot be seen with the naked eye. Parasite research has shown that the Greenland halibut concentrated in the Cabot Strait area in winter probably come from the Gulf of St. Lawrence.

Munk, P., Hansen, B.W., Nielsen, T.G., and Thomsen, H.A. 2003. Changes in plankton and fish larvae communities across hydrographic fronts off West Greenland. J. Plankton Res. 25: 815-830.

The variability in plankton community structure was studied in Disko Bay and across important fishing banks off the west coast of Greenland. The primary goal of the study was to investigate possible linkages between hydrographical processes and plankton structures, hypothesizing that hydrographic fronts would be present in the area, and that these to a large extent determine plankton distribution, composition and productivity. We sampled along four cross-shelf transects, one covering Disko Bay and Disko Bank, while the other three covered Store Hellefiske Bank, Lille Hellefiske Bank and Sukkertop Bank. The hydrography was examined by CTD profiling, the phytoplankton by fluorescence profiling and water bottle sampling, while mesozooplankton and ichthyoplankton were sampled by vertical or oblique net hauls, respectively. We observed distinct along-shelf flowing currents in the area (e.g. the West Greenland Current, the Polar Current and the Irminger Current), and the physical characteristics indicated frontogenesis at the shelf slope, in regions of 80-100 m water depth. Phytoplankton and ichthyoplankton showed a cross-shelf structuring with apparent linkages to frontal characteristics, while a more diverse pattern was observed for the mesozooplankton which were dominated by Calanus finmarchicus, Calanus glacialis and Calanus hyperboreus. The relationship between hydrographic characteristics and plankton distribution differed among species, and apparently specific plankton communities were established in different areas of the shelf. For example the larvae of *Boreogadus saida, Ammodytes* sp., *Reinhardtius hippoglossoides* and *Stichaeus punctatus* differed markedly in distributional characteristics. In addition to the cross-shelf structuring, marked differences in species composition and total plankton abundance were observed in the along- shelf (north-south) direction. The latitudinal differences in the unicellular plankton communities are interpreted largely within a seasonal successional framework (i.e. an early dominance of diatoms followed by increasing importance of smaller unicellular plankton), while the ichthyo- and zooplankton communities also differed by the respective dominance of species with polar versus temperate origin. Our findings suggest that the flow of major currents and the establishment of hydrographical fronts are of primary importance to the plankton communities in the West Greenland shelf area, influencing the early life of fish and the recruitment to the important fisheries resources.

Munoz, P.D., Troncoso, D.G., and Paz, X. 2001. Abundance and biomass for American plaice from the surveys conducted by Spain in the NAFO Regulatory Area of Divisions 3NO: 1995-2000. NAFO SCR documents 01/58: 11 p.

Spain has conducted a stratified random spring bottom trawl survey in the NAFO Regulatory Area of Div. 3NO since 1995. The depth strata was extended to 1464 m. The main purpose of the surveys was to obtain abundance and biomass indices for the commercial species in the area (American plaice *Hippoglossoides platessoides*, yellowtail flounder *Pleuronectes ferruginea*, Greenland halibut *Reinhardtius hippoglossoides*, cod *Gadus morhua*, witch flounder *Glyptocephalus cynoglossus*, roughhead grenadier *Macrourus berglax* and thorny skate *Raja radiata*). Following the recommendations of the 2000 Scientific Council Meeting, the entire series of abundance and biomass for American plaice, the description of the survey design, the specifications and the geometry of the sampling trawl used in the Spanish spring survey in Div. 3NO, are presented for the period 1995-2000. The indices calculated from the survey series, shows an increase in the abundance and biomass of American plaice in the area.

Myers, R.A. 1994. Analysis of mortality from research vessel surveys for cod and flatfish in the Northwest Atlantic. NAFO SCR documents 94/58: 33 p.

In this paper research trawl surveys in the NAFO region are examined to estimate total mortality. We examine data for most of the cod stocks within the NAFO region, and all the flatfish around Newfoundland. The purpose is to detect overall trends that may be missed in the examination of individual stocks.

Myers, R.A. and Bowering, W.R. 1995. Gill net catch per unit effort for Greenland halibut from the Canadian fishery. NAFO SCR documents 95/78: 4 p.

Catch per unit effort of Greenland halibut (*Reinhardtius hippoglossoides*) has plummeted from 1986 to 1994 in all regions. The CPUE in most inshore regions was so low by 1990 that fishing was curtailed.

Myers, R.A., Bowering, R., and Power, D. 1995. An analysis of otter trawl catch per unit effort for Greenland halibut. NAFO SCR documents 95/65: 8 p.

It is concluded that the decline in CPUE of Greenland halibut (*Reinhardtius hippoglossoides*) in the otter trawl data are seen in all the longer time series. The results do not appear to be an artifact of how the multiplicative analysis was carried out, or by interactions associated with different countries or gear types used in the analysis.

Myers, R.A., Brodie, B., Barrowman, N.J., and Bowering, R. 1995. Changes in concentration of flatfish off Newfoundland from 1971 to 1994. NAFO SCR documents 95/58: 14 p.

The degree of concentration of the flatfish was calculated by using the standard method used in econometrics to study the distribution of income among individuals. The flatfish considered are American plaice (*Hippoglossoides platessoides*), turbot (*Reinhardtius hippoglossoides*), with flounder (*Glyptocephalus cynoglossus*), and yellowtail flounder (*Limanda ferruginea*). For each year from 1971 to 1994 where data are available, a Lorenz curve is calculated for the fall research surveys in NAFO regions 2J, 3K, 3L, 3N, and 3O for the strata used in the surveys. If fish were equally distributed among strata, the Lorenz curve would be the identity function. As the distribution of fish becomes more unequal, i.e., more concentrated, the Lorenz curve bends downwards and to the right within the unit square. Twice the area between the identity function and the Lorenz curve is known as the Gini index, and is the most commonly accepted measure of the concentration. The increase in concentration of cod over time in the research surveys is clear from the Lorenz curves and the Gini index. This would make these species very vulnerable to overfishing because their catchability will be very high.

Myers, R.A., Mertz, G., Bowering, W.R., and Fowlow, P.S. 1995. The biological limits of overexploitation of Greenland halibut, *Reinhardtius hippoglossoides*. NAFO SCR documents 95/57: 8 p.

The fundamental limitations imposed by the reproductive biology of Greenland halibut, *Reinhardtius hippoglossoides* to withstand overexploitation are examined. Three stocks were examined; North East Arctic, ICES V & XIV, and Northwest Atlantic. The maximum sustainable fishing mortality using simple mathematical models was estimated as well as the maximum fishing mortality for the three slowly maturing stocks ranges from 0.3 to 0.4.

Naud, M. and Cantin, C. 1989. Potentiel economique et commercial de sept espèces marines du Québec a des fins de production aquicole. Ministère des pêches et des océans, Région du Québec, Division des services economiques, Québec. 113 p.
[In French]

Nedreaas, K. and Smirnov, O. 2003. Stock characteristics, fisheries and management of Greenland halibut (*Reinhardtius hippoglossoides* Walbaum) in the northeast Arctic. *In* Management strategies for commercial marine species in northern ecosystems: proceedings of the 10th Norwegian-Russian Symposium Bergen, Norway 27-29 August 2003. *Edited by* Bjordal, Å., Gjøsaeter, H., and Mehl, S. Institute of Marine Research, Bergen, Norway. pp. 56-78

Greenland halibut (*Reinhardtius hippoglossoides* (Walbaum)) are widely distributed over wide geographic areas of the Northeast Atlantic Ocean, with no break in the continuity of the distribution from the arctic Frans Josef Land and Novaya Zemlya archipelagos in the north and east to beyond the boreal Shetland Islands in the south. Although the entire Greenland halibut resource in the North Atlantic is genetically homogeneous, they comprise a single interbreeding stock in the Barents Sea and Norwegian Sea areas, which is known as the Northeast Arctic stock. In general, and for most of the year, larger fish become more abundant and smaller fish less abundant in progressively deeper water with peak abundance occurring over a depth range of 400-1000 m. But during the spring and summer, the mature and bigger fish may be shallower. Greenland halibut in the Northeast Atlantic were observed to be most abundant in bottom temperatures mainly between 0 degree C and 4 degree C. The fishery for Greenland halibut in the Northeast Arctic was unregulated until 1992, although since 1995 catches have substantially exceeded those advised. The spawning stock size reached historically low levels during the 1990s, and recruitment to the spawning stock remained uncertain. The stock is now showing clear signs of improvement, and is at present rebuilt to above the long-term average of the past 20 years.

Nedreaas, K., Soldal, A., and Bjordal, Å. 1993. Performance and biological implications of a multi-gear fishery for Greenland halibut (*Reinhardtius hippoglossoides)*. NAFO SCR documents 93/118: 15 p.

Nedreaas, K., Sandberg, P., and Veim, A.K. 1995. Biological and economic implications of a multi-gear fishery for Greenland halibut (*Reinhardtius hippoglossoides*). ICES CM 1995/S:5: 25 p.

This paper focuses on the level and distribution of fishing mortality in a multigear fishery, and its effect on biological and economic parameters. The Greenland halibut (*Reinhardtius hippoglossoides*) stock in ICES Sub-areas I and II is at a historically low level. Due to a lack of recruitment observed for this stock, and in order to have an increase in the spawning stock, a cessation of fishing has been advised. Since 1992 trawlers, and gillnet vessels and longliners larger than 90 feet have not been allowed to fish Greenland halibut as target species, but only as by-catch when fishing for other species. Gillnet vessels and longliners smaller than 90 feet have been allowed to participate in a directed fishery for Greenland halibut within a limited quota, a limited area and a limited period each year. This paper focuses on the economic yield one can expect from the Greenland halibut stock in ICES Sub-areas I and II when gear specific selective properties are taken into consideration. The biological data were collected during a 1992-1994 research programme using trawlers, longliners and gillnet vessels in a limited commercial fishery in the same geographical area, i.e., the historical most important fishing area. Quantitative effects of the three gears' different selectivity have been judged out from yield and spawning biomass per recruit (age 3). The profitability analysis of the different gears is based on prices and value of the catch and cost analysis of the fishery the last year of no catch-regulation (1991). Finally, the biological and economic analysis have been combined and evaluated together. The results may be used as guidelines for the management of the stock.

Nedreaas, K.H. 1998. Catch statistics and biological sampling from the Norwegian fishery in NAFO in 1995 (Revised) and 1996 (Preliminary). NAFO SCR documents 98/1: 6 p.

Two sources of fishery statistics are available from the Norwegian fishery outside the Norwegian EEZ. These are the Statlant 21A landing statistics and the logbooks written by the skipper during fishing. The landing statistics are considered to give more exact weights whereas the logbooks are more precise with regards to fishing locations. The Norwegian trawlers fishing for Greenland halibut (*Reinhardtius hippoglossoides*) concentrated all their effort to NAFO Area 1D in 1996 with a slight increase in tons/hour compared to the year before. This was also the first year Norwegian longline vessels tried and succeeded in a commercial Greenland halibut fishery at West Greenland. Length measurements of the trawl and longline catches, made by the fishermen themselves, are given. Revised catch figures for Greenland halibut taken by Norwegian vessels in Subarea 0 in 1989-1993 are presented.

Nedreaas, K.H., Soldal, A.V., and Bjordal, Å. 1996. Performance and biological implications of a multi-gear fishery for Greenland halibut (*Reinhardtius hippoglossoides*). J. Northwest Atl. Fish. Sci. 19: 59-72.

Simultaneous full-scale fishing operations using bottom trawl, gillnet and longline for *R. hippoglossoides* were performed in the Barents Sea. The mesh size of the trawl cod-end was 135 mm, and that of the gillnets 220 mm. Additionally, seven gillnet fleets of 180 mm mesh size were set for selectivity comparison. The catch rates and the length distributions of the Greenland halibut in the catches taken by the three different gears were different. Gear-specific selection properties were the main reasons for the observed differences. Fixed gears captured proportionally fewer immature fish, and thus provide greater spawning biomass and yield-per-recruit than would trawl gear, for an equivalent reference fishing mortality rate.

Nguyen, T.D.T. 2000. Fish stock assessment of the secondary species from multi-species fishery in the Barents Sea--based on Norwegian commercial catch and effort data. Thesis (Ph.D.) University of Bergen, Bergen, Norway. 49 p.

This study is based on the trawl fishery in the Barents Sea. In this fishery, cod has been the target species in many years. The studied species were: haddock, saithe, redfish and Greenland halibut, which play the secondary species role in this fishery. Stock assessment of these 4 species has been made based on the catch and effort data of the fishery. The principle of treating the effort was to standardize the fishing power of all vessels in relation to a standard vessel, and then calculate standard CPUF. From that, average monthly CPUE indices and yearly CPUE indices were produced. The estimated CPUE indices were evaluated by comparing them with other measurements of stock abundance, trawlable part from the estimated stock biomass produced by VPA and survey indices. The conclusion was that the estimated CPUE indices of haddock is the most valuable. The distribution of the fishing effort during the year and its variations in each month of the year were described. Since this is a mixed species fishery, the problem of target and non-target species has been studied as well. The result shows that cod was not always the target species. The work of the thesis is intended to contributed to stock assessment of secondary species in a multi-species fishery.

Nielsen, J.G. and Boje, J.1995. Sexual maturity of Greenland halibut at West Greenland based on visual and histological observations. NAFO SCR documents 95/18: 7 p.

Gonads from female Greenland halibut (*Reinhardtius hippoglossoides*) (Walbaum)) caught in West Greenland fjords at Uummannaq in August were examined in order to compare visual examination in field and histological analysis and to provide information on length at sexual maturity. When examined by means of histological slices, 20% of the fish were classified as juvenile/immature, compared to 33% of the fish when using visual examination. This degree of misclassification results in a discrepancy between the two estimated M sub(50) values, being 58 cm and 65 cm for the visual and histological analyses, respectively. At this state, visual examinations in the field are therefore not sufficient in order to determine sexual maturity.

Nielsen, J.G., Bertelsen, E., and Nyström, B.O. 1992. FISK i Grønlandske Farvande : en Felthåndbog . Atuakkiorfik, Nuuk, Greenland. 65 p.
[In Danish]

This book is a guide to the fish found in the North Atlantic around the coast of Greenland. The book contains colour illustrations of 95 different fish along with a description of their size and where and at what depth they are found in the ocean around Greenland.

Nielsen, J.R. 1990. Forsogsfiskeri efter hellefisk med langlinefartojet "vestfart" i Davisstraedet, November 1989. Gronlands Fiskeriundersogelser, Copenhagen (Denmark). 31 p.
[In Danish]

Nielsen, J.R. 1990. Longline fishery for Greenland halibut in the Davis Strait, November 1989. NAFO SCR documents 90/38: 4 p.

A stratified longline survey for Greenland halibut was conducted in November 1989 by the Faroese longliner Vestfart in NAFO Divisions 1B (south), 1C and 1D in the Davis Strait to investigate the possibility for a future fishery for Greenland halibut.

Niggol, K. 1982. Data on fish species from Bering Sea and Gulf of Alaska. NOAA technical memorandum NMFS F/NWC NOAA-TM-NMFS-F/NWC29: 125 p.

Mean values are presented values for two regions -- the eastern Bering Sea and Gulf of Alaska. Biometric characteristics of most species indicate that separate stocks exist in these two regions, although in some species considerable migrations and intermixing between these two areas occur. The biometric data are long-term mean values. Length and weight data are mean values for females and males together, assuming a 50:50 sex ratio. This summary contains several derived (computed) quantities, such as biomass distribution with age and age- specific total mortality, most of which are necessary for the ecosystem simulation. The annual individual growth rates are given in graphical form and the monthly growth rates of total biomass, juveniles and adults, are given in the table for given annual turnover rate of the biomass. The distribution of biomass with age for a given turnover rate and the corresponding distribution of total mortality with age (expressed as percent of mortality of the mean biomass at a given age) are given in the graphs.

Nikeshin, K.N. and Gorshkova, A.S. 1980. The selectivity of bottom trawls in fishing Greenland halibut in the central Labrador and Baffin Island area. NAFO SCR documents 80/VI/69: 10 p.

Nikolenko, L.P. 1995. Dynamics of abundance and biomass of Greenland turbot (*Reinhardtius hippoglossoides*) in western Kamchatka in 1976-1993. *In* Proceedings of the International Symposium on North Pacific Flatfish, October 26-28, 1994, Anchorage Alaska. Alaska Sea Grant Coll.Program AK-SG-95-04: pp. 467-480.

The Greenland turbot has been commercially fished in the Okhotsk Sea since 1976. Stocks inhabiting waters off western Kamchatka comprise the majority of the total catch. Some scientists believe there are several populations of turbot in the Okhotsk Sea, two of which are in the region off western Kamchatka. Based on analysis of turbot stock data (CPUE, number, biomass and age at length composition) collected between 1974 and 1993, and comparing data from the traditional turbot fishing region and the other parts of the Okhotsk Sea, we conclude that the southwestern Kamchatka stocks are replenished by fish migrating from the Sakhalin slope, and from the northern areas of the Okhotsk Sea. The strength of the turbot stocks inhabiting waters off southwestern Kamchatka was high from the mid-1980s to the early 1990s. The tendency toward decreasing biomass was first seen in 1988. This decrease was caused by the gradual reduction in recruitment beginning in 1977, and by large catches of mature turbot in the Okhotsk Sea between 1986 and 1991.

Nikolenko, L.P. 1996. Migration of Greenland turbot (*Reinhardtius hippoglossoides*) in the Okhotsk Sea. *In* Workshop on the Okhotsk Sea and Adjacent Areas, Pacific Academy of Management and Business, Vladivostok (Russia). *Edited by* Nagata, Y., Lobanov, V.B., and Talley L.D. North Pacif Marine Science Organization (PICES), Sidney, B.C. PICES scientific report 6: pp. 286-291

The Sea of Okhotsk Greenland turbot, (*Reinhardtius hippoglossoides)*, annual catch has been 15-19 thousand tons since 1976. The ecology of the species is not well understood, particularly the distribution of larvae and young up to three years old and during the pelagic phase. This information would be useful to better manage the fishery. This paper presents an analysis of ichthyoplankton survey data from surveys in 1984-1987, pelagic surveys 1985-1993 and bottom surveys 1963-1993.

Nikolenko, L.P. 1998. Distribution of eggs, larvae, and pelagic young of the Greenland turbot *Reinhardtius hippoglossoides* in the Sea of Okhotsk. Russ. J. Mar. Biol. 24: 14-18.

The results of ichthyoplankton surveys of 1984-1987 and the pelagic and bottom trawl surveys of 1963-1993 in the Sea of Okhotsk are presented. Greenland turbot larvae are mainly encountered in the northern part of the sea; high larval concentrations occur over the TINRO Basin and off northeastern Sakhalin. Larvae are transported by currents into Shelikhov and Terpeniya bays. In these bays, young fish settle onto the bottom, where they undergo further development.

Nikolenko, L.P. 1998. Distribution of the eggs, larvae and pelagic young of the Greenland turbot *Reinhardtius hippoglossoides* in the Sea of Okhotsk. Biol.Morya 24: 16-20.

The results of ichthyoplankton surveys of 1984-1987, pelagic and bottom trawl surveys of 1963-1993 in the Sea of Okhotsk are reported. Greenland turbot larvae are mainly encountered in the northern part of the Sea; higher larval concentrations are observed over the TINRO Basin and off northeastern Sakhalin. Larvae are transported by currents into Shelikhov and Terpeniya Bays. In these bays, young fish settle onto the bottom and their further development takes place.
Notes: In Russian

Nilssen, K.T., Haug, T., and Potelov, V. 1991. Field studies of harp seal Phoca groenlandica distribution and feeding ecology in the Barents Sea in September 1990. ICES CM 1991/N:3:23 p.

The harp seal *Phoca groenlandica* is the most abundant seal species in the Barents Sea. In order to evaluate the ecological role of harp seals, field studies, including both analysis of harp stomach contents and concurrent estimates of prey abundance, were carried out in the Barents Sea during August/September 1990. It appeared that, at this time of the year, the harp seals were confined to the northmost areas of this sea, either close to or within the pack ice belt. Trawl surveys revealed that the most abundant food resources in sea surface layers in areas close to the pack ice belt were the amphipod *Parathemisto libellula* and krill *Thysanoessa* spp. The fish fauna is poor, and occurs mainly near the bottom. Numerically, capelin *Mallotus villosus* and polar cod *Boreogadus saida* dominated, but also long rough dab *Hippoglossoides platessoides* , Greenland halibut *Reinhardtius hippoglossoides* , snailfish *Liparis fabricii* and Atlantic poacher *Leptagonus decagonus* occurred quite frequently.

Nizovtsev, G.P. 1974. Greenland halibut *Reinhardtius hippoglossoides* (Walbaum), tagged in the waters of eastern Iceland and caught in the Barents Sea. Vopr. Ikhtiol. 14: 328.
[In Russian]

Nizovtsev, G.P. 1987. Growth pattern of Greenland halibut (*Reinhardtius hippoglossoides* W.) from the northeast Atlantic. NAFO SCR documents 87/89: 20 p.

Nizovtsev, G.P. 1988. O vozmozhnosti prognozirovaniya velichiny ezhegodnogo popolneniya promyslovoj chasti stada chernogo paltusa Barentseva i Norvezhskogo morej po chislennosti proizvoditelej [A method of forecasting the level of annual recruitment to the fishing portion of Greenland halibut stock of the Barents and Norwegian seas by the abundance of parent stock]. *In* Biologiya Ryb v Moryakh Evropejskogo [Biology of fish in the seas of the European north]. pp. 35-41.
[In Russian]

Halibut (*Reinhardtius hippoglossoides*) collected in the Barents and eastern Norwegian Seas in 1965-1985 were used. The average number of fish aged 6 and 7 years per an average one hour haul was taken as index of the annual recruitment to the fishing part of the stock. Two equations are presented and discussed which allow to project annual recruitment to the fishing stock of Greenland halibut six years in advance. The author found a linear relationship between the abundance of parent stock and progeny which is only slightly obscured by natural fluctuations at the early stages of development.

Nizovtsev, G.P. 1989. On the relationship between recruitment and the maternal stock of Greenland halibut in the Barents and Norwegian Seas. *In* The early life history of fish: the third ICES symposium, Bergen, 3-5 October 1988 . Edited by Blaxter, J. H. S., Gamble, J. C., and Westernhagen, H. V. ICES Marine Science Symposia, Bergen, Norway. Rapports et proces-verbaux des reunions; 191: p. 471.

The relationship between mature and immature Greenland halibut (*Reinhardtius hippoglossoides*) in age classes and age of recruits was elucidated from material collected in the Barents and eastern Norwegian Seas in 1965-1985. The abundance of the commercial part of the population, of its spawning component and recruitment vary simultaneously. These data suggest that the size of annual recruitment depends mainly on the abundance of the maternal stock. Correlation analysis elucidated the direct relationship between the relative index of abundance of the spawning part of the stock and the relative abundance of recruits. The relationship is real and stable and enables a forecast of the magnitude of annual recruitment six years in advance.

Nizovtsev, G.P. 1989. New information on the distribution of Greenland halibut, *Reinhardtius hippoglossoides* in the North Atlantic. J. Ichthyol. 29: 113-117.
[Translated from Russian: Novye svedeniya o rasprostranenii chernogo paltusa Reinhardtius hippoglossoides v Severoj Atlantike IN: Voprosy Ikhtiologii, vol. 29, no. 5, 1989, p. 856-860

Details are given of the *Reinhardtius hippoglossoides* specimens collected in the northeastern part of the Atlantic during 1976-81, including data regarding the sex ratio, stages of maturity and feeding.

Nizovtsev, G.P. 1989. Novye svedeniya o rasprostranenii chernogo paltusa *Reinhardtius hippoglossoides* v Severoj Atlantike [New information on the range of the Greenland halibut, *Reinhardtius hippoglossoides*, in the North Atlantic]. Vopr. Ikhtiol. 29: 856-860. [In Russian]

The paper is based on material collected in the North Atlantic in 1976-1981. A total of 707 halibut (*Reinhardtius hippoglossoides*) were caught from the western slopes of Rockall, Hutton, Outer Bayley and George Bligh submarine elevations from about 54 degree N to the western slope of the Faeroes-Iceland Ridge. This extends the range of the halibut from continental and insular slopes to deepwater submarine elevations at a considerable distance from continents and islands. Data on the sex composition, maturing stages and food habits of the Greenland halibut are provided.

Nizovtsev, G.P. 1991. Growth patterns of Greenland halibut (*Reinhardtius hippoglossoides*) in the Northeast Atlantic. Northwest Atl. Fish. Organ. Sci. Counc. Stud. 15: 35-41.

The patterns and peculiarities of linear and weight of Greenland halibut (*Reinhardtius hippoglossoides*) from the Barents Sea and Icelandic waters are investigated. Notable variations in length and weight typical of males and females from the same age group reflect the apparent adaptation of fish to fuller consumption of food and to regular recruitment. Males under 5 and 7 years of age of both areas are longer than females of the same age. The linear growth of Greenland halibut follows the pattern common to most fishes with the yearly length increments greatest for the young and lowest for the old fish.

Njaa, L.R. 1990. Amino acid contents of fillet protein from 13 species of fish. Fiskeridir. Skr. Ser. Ernaer. 3: 43-45.

Fish fillets of 13 species were analysed for amino acid contents: Cod (*Gadus morhua*); Saithe (*Pollachius virens*); Haddock (*Melanogrammus aeglefinus*); Pollack (*Pollachius pollachius*); Ling (*Molva molva*); Tusk (*Brosme brosme*); Redfish (*Sebastes marinus*); Catfish (*Anarhichas lupus*); Halibut (*Hippoglossus hippoglossus*); Greenland halibut (*Reinhardtius hippoglossoides*); Eel (*Anguilla anguilla*); Mackerel (*Scomber scombrus*); Herring (*Clupea harengus*).

Nordic Council of Minsters and International Council for the Exploration of the Sea. 2000. The status of fisheries and related environment of northern seas. Nord 2000:10: 163 p.

Northwest Atlantic Fisheries Organization. Secretariat. 1980. Historical catches of selected species by stock area and country for the period 1969-78. NAFO SCS documents 80/VI/11: 38 p.

This report includes a listing for the catches of commercial marine species by fishing countries over a ten-year period

Northwest Atantic Fisheries Organization. Secretariat. 1980. Tagging activities reported for the Northwest Atlantic in 1979 and supplementary data for 1976-78. NAFO SCS documents 80/VI/7: 10 p.

Northwest Atantic Fisheries Organization. Secretariat. 1981. Tagging activities reported for the Northwest Atlantic in 1980. NAFO SCS documents 81/VI/6: 13 p.

Northwest Atlantic Fisheries Organization. Secretariat. 1981. Historical catches of selected species by stock area and country for the period 1970-79. NAFO SCS documents 81/VI/10: 38 p.

Northwest Atlantic Fisheries Organization. Secretariat. 1982. Historical catches of selected species by stock area and country for the period 1971-80. NAFO SCS documents 82/VI/2: 38 p.

Northwest Atlantic Fisheries Organization. Secretariat. 1982. Tagging activities reported for the northwest Atlantic in 1981. NAFO SCS documents 82/VI/4: 6 p.

Northwest Atlantic Fisheries Organization. Secretariat. 1983. Historical catches of selected species by stock area and country for the period 1972-81. NAFO SCS documents 84/VI/6: 38 p.

Northwest Atlantic Fisheries Organization. Secretariat. 1983. Tagging activities reported for the northwest Atlantic in 1982. NAFO SCS documents 83/VI/8: 6 p.

Northwest Atantic Fisheries Organization. Secretariat. 1984. Tagging activities reported for the Northwest Atlantic in 1983 and additional information for earlier years. NAFO SCS documents 84/VI/5: 5 p.

Northwest Atlantic Fisheries Organization. Secretariat. 1985. Historical catches of selected species by stock area and country for the period 1973-83. NAFO SCS documents 85/9: 38 p.

Northwest Atlantic Fisheries Organization. Secretariat. 1985. Tagging activities reported for the Northwest Atlantic in 1984. NAFO SCS documents 85/4: 6 p.

Northwest Atlantic Fisheries Organization. Secretariat. 1986. Historical catches of selected species by stock area and country for the period 1963-84. NAFO SCS documents 86/2: 73 p.

Northwest Atantic Fisheries Organization. Secretariat. 1987. Tagging activities reported for the Northwest Atlantic in 1986. NAFO SCS documents 87/08: 5 p.

Northwest Atlantic Fisheries Organization. Secretariat. 1987. Historical catches of selected species by stock area and country for the period 1975-85. NAFO SCS documents 87/03: 38 p.

Northwest Atlantic Fisheries Organization. Secretariat. 1988. Historical catches of selected species by stock area and country for the period 1976-86. NAFO SCS documents 88/01: 38 p.

Northwest Atantic Fisheries Organization. Secretariat. 1988. Tagging activities reported for the Northwest Atlantic in 1987. NAFO SCS documents 88/07: 4 p.

Northwest Atlantic Fisheries Organization. Secretariat. 1990. A compilation of research vessel surveys on a stock by stock basis. NAFO SCS documents 90/22: 17 p.

Northwest Atlantic Fisheries Organization. Secretariat. 1990. Historical catches of selected species by stock area and country for the period 1978-88. NAFO SCS documents 90/1: 38 p.

Northwest Atlantic Fisheries Organization. Secretariat. 1990. Tagging activities reported for the Northwest Atlantic in 1989. NAFO SCS documents 90/11: 6 p.

Northwest Atantic Fisheries Organization. Secretariat. 1991. Tagging activities reported for the Northwest Atlantic in 1990 NAFO SCS documents 91/7: 3 p.

Northwest Atlantic Fisheries Organization. Secretariat. 1991. Compilation of research vessel surveys on a stock-by-stock basis. NAFO SCS documents 91/18: 18 p.

Northwest Atlantic Fisheries Organization. Secretariat. 1991. Historical catches of selected species by stock area and country for the period 1979-89. NAFO SCS documents 91/1: 38 p.

Northwest Atantic Fisheries Organization. Secretariat. 1992. Tagging activities reported for the Northwest Atlantic in 1991. NAFO SCS documents 92/8: 3 p.

Northwest Atlantic Fisheries Organization. Secretariat. 1992. A compilation of research vessel surveys on a stock-by-stock basis. NAFO SCS documents 92/22: 18 p.

Northwest Atantic Fisheries Organization. Secretariat. 1993. Tagging activities reported for the Northwest Atlantic in 1992. NAFO SCS documents 93/7: 2 p.

Northwest Atlantic Fisheries Organization. Secretariat. 1993. A compilation of research vessel surveys on a stock-by-stock basis. NAFO SCS documents 93/18: 21 p.

Northwest Atantic Fisheries Organization. Secretariat. 1994. Tagging activities reported for the Northwest Atlantic in 1993. NAFO SCS documents 94/7: 3 p.

Northwest Atlantic Fisheries Organization. Secretariat. 1994. A compilation of research vessel surveys on a stock-by-stock basis. NAFO SCS documents 94/18: 19 p.

Northwest Atantic Fisheries Organization. Secretariat. 1995. Tagging activities reported for the Northwest Atlantic in 1994 . NAFO SCS documents 95/7: 4 p.

Northwest Atlantic Fisheries Organization. Secretariat. 1995. A compilation of research vessel surveys on a stock-by-stock basis. NAFO SCS documents 95/17: 19 p.

Northwest Atantic Fisheries Organization. Secretariat. 1996. Tagging activities reported for the Northwest Atlantic in 1995. NAFO SCS documents 96/8: 2 p.

Northwest Atlantic Fisheries Organization. Secretariat. 1996. A compilation of research vessel surveys on a stock-by-stock basis. NAFO SCS documents 96/15: 21 p.

Northwest Atantic Fisheries Organization. Secretariat. 1997. Tagging activities reported for the Northwest Atlantic in 1996. NAFO SCS documents 97/15: 4 p.

Northwest Atlantic Fisheries Organization. Secretariat. 1997. A compilation of research vessel survey on a stock-by-stock basis. NAFO SCS documents 97/13: 20 p.

Northwest Atantic Fisheries Organization. Secretariat. 1998. Tagging activities reported for the Northwest Atlantic in 1997. NAFO SCS documents 98/4: 3 p.

Northwest Atlantic Fisheries Organization. Secretariat. 1998. A compilation of research vessel surveys on a stock-by-stock basis. NAFO SCS documents 98/18: 21 p.

Northwest Atantic Fisheries Organization. Secretariat. 1999. Tagging activities reported for the Northwest Atlantic in 1998. NAFO SCS documents 99/10: 3 p.

Northwest Atantic Fisheries Organization. Secretariat. 1999. Tagging activities reported for the Northwest Atlantic in 1999. NAFO SCS documents 00/5: 5 p.

Northwest Atlantic Fisheries Organization. Secretariat. 2000. A compilation of research vessel surveys on a stock-by-stock basis. NAFO SCS documents 00/28: 25 p.

Northwest Atlantic Fisheries Organization. Secretariat. 2000. Historical catches of selected species by stock area and country for the period 1983-93. NAFO SCS documents 95/5: 26 p.

Northwest Atlantic Fisheries Organization. Secretariat. 2000. Historical nominal catches for selected stocks. NAFO SCS documents 00/12: 5 p.

Northwest Atantic Fisheries Organization. Secretariat. 2001. Historical nominal catches for selected stocks. NAFO SCS documents 01/10: 5 p.

Northwest Atantic Fisheries Organization. Secretariat. 2001. Stock-by-stock research vessel surveys reported during 1990-2000. Northwest Atl. Fish. Organ. Sci. Counc. Stud. 34: 19-83.

The Scientific Council at its meeting in June 1990 agreed to compile an inventory and information on research vessel surveys conducted with respect to stocks assessed by the Scientific Council (SCS Doc. 90/22). This inventory was judged to be a useful reference and very helpful for the establishment of other inventories. During its meeting in June 1991 the Council agreed that the Designated Experts for the stocks should update the information annually for review of STACFIS. In 1991 and the subsequent years through the decade, the inventory has been compiled annually and presented to the Scientific Council in the form of Scientific Council Summary Documents (SCS Doc.). The tabulations in this paper were compiled by the Secretariat in order to provide a comprehensive overview of surveys during the 1990-2000 decade used for stock assessments by the Scientific Council. Information supplied in the SCS Documents were collated and edited as needed, and the SCR Documents cited in them were checked and corrections made to the tables when necessary. This paper is compiled in the format designed by the Scientific Council in 1990s. Stock-by-stock tabulations are listed with the northernmost stock first and progress southward from Subarea 0 to 4.

Northwest Atantic Fisheries Organization. Secretariat. 2001. Tagging activities reported for the Northwest Atlantic in 2000. NAFO SCS documents 01/16: 2 p.

Northwest Atlantic Fisheries Organization. Secretariat. 2001. A compilation of research vessel surveys on a stock-by-stock basis. NAFO SCS documents 01/27: 22 p.

Northwest Atantic Fisheries Organization. Secretariat. 2001. STATLANT 21 reported catches by stock tabulated against STACFIS estimates, 1985-1999. NAFO SCS documents 01/5: 23 p.

Northwest Atantic Fisheries Organization. Secretariat. 2002. Tagging activities reported for the Northwest Atlantic in 2001 and eary-2002. NAFO SCS documents 02/17: 19 p.

Northwest Atlantic Fisheries Organization. Secretariat. 2002. A compilation of research vessel surveys on a stock-by-stock basis. NAFO SCS documents 02/23: 23 p.

Northwest Atlantic Fisheries Organization. Secretariat. 2002. Historical nominal catches for selected stocks. NAFO SCS documents 02/13: 7 p.

Northwest Atlantic Fisheries Organization. Secretariat. 2003. A compilation of research vessel surveys on a stock-by-stock basis. NAFO SCS documents 03/26: 14 p.

Northwest Atlantic Fisheries Organization. Secretariat. 2003. Historical nominal catches for selected stocks. NAFO SCS documents 03/12: 7 p.

Northwest Atlantic Fisheries Organization. Secretariat. 2003. Report of NAFO Scientific Council Workshop on the precautionary approach to fisheries management. NAFO SCS documents 03/05: 59 p.

Northwest Atlantic Fisheries Organization. Scientific Council. 1991. Report of Scientific Council, June 1991 meeting. NAFO SCS documents 91/19: 125 p.

Northwest Atlantic Fisheries Organization. Scientific Council. 1992. Report of Scientific Council, June 1992 meeting. NAFO SCS documents 92/23: 151 p.

Northwest Atlantic Fisheries Organization. Scientific Council. 1993. Report of Scientific Council, 19-23 November 1993 meeting. NAFO SCS documents 93/21: 19 p.

Northwest Atlantic Fisheries Organization. Scientific Council. 1993. Report of Scientific Council, 2-16 June 1993. NAFO SCS documents 93/17: 154 p.

Northwest Atlantic Fisheries Organization. Scientific Council. 1994. Report of Scientific Council, 8-22 June 1994 meeting. NAFO SCS documents 94/19: 134 p.

Northwest Atlantic Fisheries Organization. Scientific Council. 1998. Report of Scientific Council Workshop on the precautionary approach to fisheries management. NAFO SCS documents 98/1: 60 p.

The Scientific Council, in recognizing that implementation of the precautionary approach to fisheries management would be challenging and an ongoing process, initiated development of a framework and action plan, and arranged for a Scientific Council Workshop on the Precautionary Approach to Fisheries Management, to meet during 17-27 March 1998 in Dartmouth, Nova Scotia (Canada). The workshop addressed the following terms of reference: 1) describe procedures for determining limit and target reference points under the various levels of stock-specific information; 2) determine the limit and target precautionary reference points for all stocks under the responsibility of NAFO Fisheries Commission i.e. northern cod (*Gadus morhua*), American plaice (*Hippoglossoides platessoides*), yellowtail flounder (*Pleuronectes ferrugineus*), witch flounder (*Glyptocephalus cynoglossus)*, redfish (*Sebastes* spp.), Greenland halibut (*Reinhardtius hippoglossoides*), capelin (*Mallotus villosus)*, northern shrimp (*Pandalus borealis)*, and northern shortfin squid (*Illex illecebrosus*); 3) specify decision rules; 4) develop criteria to be used in consideration of possible fisheries re-openings; 5) identify data collection and monitoring activities required to reliably evaluate resource status with respect to reference points; 6) define research requirements to improve the quantification and evaluation of uncertainty as well as methodological developments to reduce uncertainty and; 7) indicate time frames and funding required to successfully implement the precautionary approach.

Northwest Atlantic Fisheries Organization. Scientific Council. 1998. Report of Scientific Council Workshop on the precautionary approach to fisheries management, 17-27 March 1998. NAFO SCS documents 62 p.

Noskov, A.S., Borovkov, V.A., Chumakov, A.K., and Kovalev, S.M. 1988. USSR research report for 1987. NAFO SCS documents 14 p.

Novikov, N.P. 1961. Bering Sea halibuts. Can. Transl. Fish. Aquat. Sci. 329: 4 p.
[Translated from Russian; Original appeared in: Rybnoe khoziaistvo. 36(1): 12-15, 1960]

In 1957, TINRO conducted a study of all aspects of the fisheries resources of the Bering Sea, in the course of which data on the biology and distribution of halibut were obtained.

Oehlenschlaeger, J. 1991. Phosphor- und Fettgehalte im Muskel von mittelfetten und fetten Seefischarten aus dem Nordatlantik [Phosphorus and fat content in muscles of seafish from the North Atlantic]. Inf. Fischwirtsch. 38: 24-31.
[In German]

The phosphorus content of the muscles of a number of more or less fat fishes was measured, since detailed data on the muscle phosphorus content of these fishes is still lacking. Highest phosphorus content was found for herring (*Clupea harengus*) (272 mg/100 g fresh ww) and lowest for sea perch (*Helicolenus dactylopterus*, 123 mg/100 g fresh ww). Mackerel (*Scomber scombrus*), black halibut (*Reinhardtius hippoglossoides*), horse mackerel (T*rachurus trachurus*) redfish (*Sebastes marinus* and *S. mentella*), plaice (*Pleuronectes platessa*) and white halibut (*Hippoglossus hippoglossus*) revealed phosphorus contents in between.

Ogawa, M., Yokawa, K., and Jørgensen, O. 1994. Results of a stratified random bottom trawl survey off West Greenland in 1993. NAFO SCR documents 94/31.

Since 1987 Japan Marine Fishery Resource Research Center (JAMARC) and Greenland Fisheries Research Institute (GFRI) have conducted cooperative trawl surveys off West and East Greenland. In 1993 one stratified random bottom trawl survey was carried out off West Greenland. the aim of survey was to estimate stock sizes of groundfishes and to obtain information on distribution, size composition and biology of Greenland halibut (*Reinhardtius hippoglossoides*), beaked redfish (*Sebastes mentella)* and roundnose grenadier (*Coryphaenoides rupestris*) on the continental slope between Div. 1A (south of 70 deg N) and 1D.

Okiyama, M. and Takahaski, K. 1976. Larval stages of the right eye flounders subfamily Pleuronectinae occurring in the Japan Sea. Bull. Jpn. Sea Natl. Fish. Res. Inst. 27: 11-34.
[In Japanese, English summary]

Larval stages were described and illustrated for 7 spp. of right eye flouders (Pleuronectinae) occurring in the Japan Sea: *Hippoglossoides dubius, Cleisthenes herzensteini, Eopsetta grigorjewi, Verasper moseri, Lepidopsetta mochigarei, Tanakius kitaharai and Microstomus achne.* Identifications were made mostly on the basis of the pigmentation patterns, meristic counts and resemblances with the described larvae. Early life history stages were clarified for 26 of 28 Japan Sea pleuronectid fish. No information was avaiable for *Clidoderma asperrimum* and *Dexistes rikuzenius.* Diagnostic characters such as meristic counts, sizes at metamorphosis, larval characters and pigmentation were reviewed to illustrate the general accounts of their features. Included were the remarkable variations of the numbers of the caudal vertebrae, the close relationship between the vertebral numbers and sizes at metamorphosis, the sporadic natures of the head armature development (preopercular spines in *Reinhardtius*, *Glyptocephalus* and

Tanakius); sphenotic spine in *Microstomus*, etc. Phylogenetic aspects of this subfamily were discussed briefly, taking into account the larval characteristics. Although the division of the large and small mouth forms appeared reasonable from the larval standpoint, no reliable links among the genera were apparent.

Olafur, K.P., Steinarsson, B.A., Johnsson, E., Gudmundsson, G., Jonsson, G., Stefansson, G., Bjoernsson, N., and Schopka, S.A. 1997. Icelandic groundfish survey. ICES CM 1997/Y:29: 35 p.

The objective of the Icelandic Groundfish Survey (IceGFS) is to improve the scientific basis of fisheries management and thus increase consistency and reliability of management advice for demersal fish stocks in Icelandic waters. The survey has been carried out annually in March since 1985, covering the continental shelf waters around Iceland with 540-600 "semi-randomly" distributed tows. Biological data are collected for all fish species although sampling effort is basically related to economic importance of each species. At present length data are collected for all species, age data for 11 species and weight data for 3 species (cod (*Gadus morhua)*, haddock (*Melanogrammus aeglefinus*) and saithe (*Pollachius virens*)). Stomach content is analyzed for cod. Standard environmental information (weather, sea conditions, etc.) including sea temperature is collected on every tow. Survey results have been used to monitor biological status (weight at age, maturity status), to predict recruitment and for assessment calibrations of cod and haddock. For several other demersal species indices for catchable stock and recruitment have been used to monitor status of the stocks and to support management advice. Analysis of trends in catchability of cod in the survey have given negative results, i.e. significant trends have not been observed. In general the survey has met its objectives quite well. However, an important critique relates to reduced catchability of mature cod in the main spawning area off the southwestern coast and, therefore, less weight of spawning stock indices in assessments calibrations. Another critique is the fact that saithe is not adequately covered in the survey due to the pelagic behavior of the species.

Olsen, H.E. 1972. Report on experimental fishing trials for Greenland turbot (halibut) with longlines at Newfoundland, Labrador and Greenland with M/V KORALEN. Can. Transl. Fish. Aquat. Sci. 2158: 10 p.
[Translated from Norwegian; Original appeared in: Fiskets Gang. 57(44): 809-815, 1971]

The report includes the area surveyed, ice conditions, and the catch statistics for the various fishing areas.

Olsen, J.B. 1995. Denmark (Greenland) request for scientific advice on management of certain stocks in 1996. NAFO SCS documents 95/1: 2 p.

Olsen, J.B. 1997. Denmark (Greenland) request for scientific advice on management of certain stocks in 1998. NAFO SCS documents 97/2: 1 p.

Olsen, J.B. 2000. Denmark (Greenland) request for scientific advice on management in 2002 of certain stocks in Subareas 0 and 1. NAFO SCS documents 01/3: 1 p.

Olsen, J.B. 2000. Denmark (Greenland) request for scientific advice on management in 2001 of certain stocks in Subareas 0 and 1. NAFO SCS documents 00/2: 1 p.

Orlov, A.M. 1997. Ecological characteristics of the feeding of some Pacific predatory fish of south-east Kamchatka and northern Kuril Islands. Russ. J. Aquat. Ecol. 6: 59-74.

The results of shipboard express-analysis of the stomach content of the sablefish Anoplopoma fimbria, the Greenland turbot *Reinchardtius hippoglossoides matsuurae*, the Kamchatka flounder *Atherestes evermanni* and the Pacific halibut *Hippoglossus*

stenolepis off Southeast Kamchatka and the North Kuril Islands (Russia) between 1992 and 1996 are used to qualitatively assess the composition of the diet. Its variations in relation to sex and size of fish, depth, time of the day and fishing season are analyzed.

Orlov, A.M. 1997. Role of fishes in predator diets of the Pacific slope of the northern Kuril Islands and southeastern Kamchatka. *In* Forage fishes in marine ecosystems: proceedings of the International symposium on the role of forage fishes in marine ecosystems. University of Alaska Fairbanks, Fairbanks, Alaska. Lowell Wakefield Fisheries Symposia Series; 14; Alaska Sea Grant College Program report; AK-SG-97-01 pp. 209-229.

The most abundant predatory fishes of the Pacific slope of the northern Kuril Islands are three pleuronectids: Kamchatka flounder (*Atheresthes evermanni)*, Greenland halibut (*Reinhardtius hippoglossoides matsuurae*), and Pacific halibut (*Hippoglossus stenolepis*). Data on the diets of these species were collected during 1992-1996. In all, 1,441 stomachs of Kamchatka flounder, 1,283 stomachs of Greenland halibut, and 600 stomachs of Pacific halibut were analyzed. The species composition of the stomach contents was determined for 752, 411, and 468 stomachs, respectively. Forage fishes were frequently observed in stomachs of Greenland halibut (31.5%), which feed mainly on Commander squid, *Berryteuthis magister*. The frequency of forage fishes in stomachs of Kamchatka flounder was somewhat higher (36.8%). Pacific halibut, which feed mainly on cephalopods and macrobenthos, had the lowest frequency of forage fishes (25.4%). Greenland halibut had the most narrow range of fish in the diet. It included species of nine families, of which liparids and mesopelagic myctophids and microstomatids were most frequent. Kamchatka flounder fed mainly on sculpins, liparids, and myctophids. Pacific halibut fed most often on gadids (mainly pollock) and sculpins. All three predators ate walleye pollock, Theragra chalcogramma (Gadidae); Elassodiscus sp. (Liparidae); Triglops sp. (Cottidae); and the fathead sculpin Malacocottus zonurus (Psychrolutidae). The diets of all three predators differed according to size and sex, season, time of day, and depth of trawl.

Orlov, A.M. 1999. Some aspects of trophic relations among Pacific predatory fishes off the northern Kuril Islands and southeastern Kamchatka. *In* GUTSHOP '98 : fish feeding ecology and digestion : symposium proceedings , 41-52. 1999. *Edited by* MacKinlay, D. and Houlihan, D. Fisheries and Oceans Canada, Vancouver, B.C. pp. 41-52.

On the basis of shipboard scans of stomach contents made during 1992-1996 in the Pacific waters off the northern Kuril Island and southeastern Kamchatka some aspects of trophic relations among Greenland turbot *Reinhardtius hippoglossoides*, Kamchatka flounder *Atherestes evermanni*, Pacific halibut *Hippoglossus stenolepis*, sablefish *Anoplopoma fimbria*, snailfish *Polypera simushirae*, Pacific cod *Gadus macrocephalus*, Aleutian skate *Bathyraja aleutica*, whiteblotched skate B*athyraja maculata,* Matsubara's skate *Bathyraja matsubarai*, Alaska skate *Bathyraja parmifera*, shortraker rockfish *Sebastes borealis*, shortspine thornyhead *Sebastolobus alascanus*, broadbanded thornyhead *Sebastolobus macrochir*, and rock greenling *Hexagrammos lagocephalus*, are considered. Comparison of their diets, features of interannual feeding intensity, bathymetric patterns, and maps of spatial distribution showed that the highest level of feeding competition among species considered was characteristic of shortraker rockfish and broadbanded thornyhead.

Orlov, A.M. and Moukhametov, I.N. 2003. Feeding characteristics of Greenland halibut *Reinhardtius hippoglossoides matsuurae* and Kamchatka flounder *Atheresthes evermanni* in the northwestern part of the Pacific Ocean. J. Ichthyol. 43: 789-801.

Feeding of Greenland halibut *Reinhardtius hippoglossoides matsuurae* and Kamchatka flounder *Atheresthes evermanni* in the western part of the Bering Sea and in the Pacific waters of the northern Kurils and southwestern Kamchatka is considered. The main food items of both predators are shrimps, cephalopods, and fish. In the western part of the Bering Sea, a large part of the food of both species consists of the offal from fish processing. Changes in the food composition depending on the fish length, sex, depth, and fishing area are analyzed. Similarities in the food composition in various size groups in both areas are estimated.

Orlov, A.M. and Mukhametov, I.N. 2003. Feeding characteristics of Greenland halibut *Reinhardtius hippoglossoides matsuurae* and Kamchatka flounder *Atheresthes evermanni* in the northwestern part of the Pacific Ocean. Vopr. Ikhtiol. 43: 822-834. [In Russian]

Feeding of Greenland halibut *Reinhardtius hippoglossoides matsuurae* and Kamchatka flounder *Atheresthes evermanni* in the western part of the Bering Sea and in the Pacific waters of the northern Kurils and southwestern Kamchatka is considered. The main food items of both predators are shrimps, cephalopods, and fish. In the western part of the Bering Sea, a large part of the food of both species consists of the offal from fish processing. Changes in the food composition depending on the fish length, sex, depth, and fishing area are analyzed. Similarities in the food composition in various size groups in both areas are estimated.

Orlov, A.M. and Moukhametov, I.N. 2004. Feeding habits of Pacific black halibut (*Reinhardtius hippoglossoides matsuurae* Jordan et Snyder, 1901) and Kamchatka flounder (*Atheresthes evermanni* Jordan et Starks, 1904) in the western North Pacific. Bull. Sea Fish. Inst. Gdynia 161: 43-58.

The diets of Pacific black halibut *Reinhardtius hippoglossoides matsuurae* and Kamchatka flounder *Atheresths evermanni* inhabiting the western Bering Sea and Pacific waters off the northern Kuril Islands (Russia) and southeastern Kamchatka (Russia) were examined. The diets of both predators consisted mostly of shrimps, cephalopods and fishes. The consumption of large amounts of fishery offal by Pacific black halibut and Kamchatka flounder in the western Bering Sea was noted. The diets of the species considered in both study areas were compared. The effect of fish size, capture depth, area and sex on diet variation were analyzed.

Orr, D.C. and Bowering, W.R. 1997. A multivariate analysis of food and feeding trends among Greenland halibut (*Reinhardtius hippoglossoides*) sampled in Davis Strait, during 1986. ICES J. Mar. Sci. 54: 819-829.

Pelagic invertebrates (northern shrimp (*Pandalus borealis*), *Cephalopoda, Mysidacea, Amphipoda and Euphausiacea*) and fish (redfish (*Sebastes mentella*), *R. hippoglossides* and Arctic cod (*Boreogadus saida*)) were the most important food items found in 4295 Greenland halibut (*R. hippoglossides*) stomachs collected from Davis Strait (Northwest Atlantic Fisheries Organization (NAFO) Subareas 0 and 1), during 1986. Ordination methods indicated that predator size and capture depth accounted for 85.2% of the variation in diet, while classification methods were used to illustrate these relationships. Additionally, the study extended into locations not previously sampled, therefore, knowledge was expanded upon pertaining to the distribution ranges of important prey.

Orr, D.C. and Bowering, W.R. 1999. A multivariate analysis of food and feeding trends among Greenland halibut (*Reinhardtius hippoglossoides*) sampled in Davis Strait, during 1986. *In* Ecology, fisheries and management of Greenland halibut (*Reinhardtius hippoglossoides* (Walbaum)) in the Canadian Northwest Atlantic. *Edited by* W.R.Bowering. University of Bergen, Bergen (Norway). Thesis (Ph.D.) University of Bergen, Bergen, Norway. 10 p.

Pelagic invertebrates [northern shrimp (*Pandalus borealis*), *Cephalopoda, Mysidacea, Amphipoda* and *Euphausiacea*] and fish [redfish (*Sebastes mentella*), *R. hippoglossoides* and Arctic cod (*Boreogadus saida*)] were the most important food items found in 4295 Greenland halibut (*R. hippoglossoides*) stomachs collected from Davis Strait [North-west Atlantic Fisheries Organization (NAFO) Subareas 0 and 1], during 1986. Ordination methods indicated that predator size and capture depth accounted for 85.2% of the variation in diet, while classification methods were used to illustrate these relationships. Additionally, the study extended into locations not previously sampled, therefore, knowledge was expanded upon pertaining to the distribution ranges of important prey.

Orr, D.C., Parsons, D.G., Atkinson, D.B., Veitch, P.J., and Sullivan, D. 1999. Information pertaining to northern shrimp (*Pandalus borealis*) and groundfish in NAFO Divisions 3LNO. NAFO SCR documents 99/102: 25 p.

Data on northern shrimp (*Pandalus borealis)* in Division 3LNO have been collected each autumn since 1995, as part of the Canadian multi-species research surveys. Biomass and abundance indices resulting from these surveys indicate that the resource has been increasing. The stock, which extends beyond Canada's 200 Nmi limit, overlaps several groundfish species presently under moratoria. This paper provides biomass and abundances indices for the entire 3LNO, as well as, that area outside Canada's 200Nmi limit and describes 3LNO shrimp distributions relative to distributions of various groundfish distributions, as requested by the Fisheries Commission of NAFO in 1998.

Orr, D.C., Veitch, P., and Sullivan, D. 2000. An update of information pertaining to northern shrimp (*Pandalus borealis*) and groundfish in NAFO divisions 3LNO. NAFO SCR documents 00/85: 33 p.

This document describes the status of the Div. 3L northern shrimp (*Pandalus borealis*) stock, as well as the effect of the 2000 shrimp fishery upon it. The description of the fishery includes preliminary catch-per-unit-effort (CPUE) and fishing mortality (catch/biomass) estimates. An overview of by catch of various groundfish in the shrimp fishery is also provided. The distributions of adult and juvenile Atlantic cod (*Gadus morhua*), American plaice (*Hippoglossoides platessoides)*, Greenland halibut (*Reinhardtius hippoglossoides*) and redfish (*Sebastes mentella*) were plotted to learn the degree of overlap with the fishery. The various distributions were compared with shrimp distributions to determine degrees of overlap.

Orr, D.C., Kulka, D.W., Veitch, P.J., and Firth, J. 2000. Bycatch of Greenland halibut (*Reinhartius hippoglossoides*) in the offshore shrimp fishery. Canadian Stock Assessment Secretariat research document; 2000/70: 26 p.

This paper quantifies the impact of 1997 - 1999 2GHJ3K Greenland halibut bycatch, taken by the offshore component of the shrimp fishing fleet. Analyses indicated that Greenland halibut were abundant and broadly distributed over the entire study area, and that the impact of present bycatch levels could not be detected.

Orr, D.C., Parsons, D.G., Veitch, P., and Sullivan, D. 2001. An update of information pertaining to northern shrimp (*Pandalus borealis*) and groundfish in NAFO divisions 3LNO. NAFO SCR documents 01/186: 49 p.

Since 1995, Canadian multi-species stratified random surveys have been used to estimate northern shrimp (*Pandalus borealis*, Krøyer) biomass and abundances in Division 3LNO. Biomass increased from 5,921 tons in 1995 to 121,815 tons during spring 2000, and then decreased to the estimated 103,451 tons in spring 2001. Data from these surveys were used in age, relative year-class strength and year-class progression determinations. Preliminary total instantaneous mortality rates are estimated. Fisheries data were used in determining Catch-Per-Unit-Effort (CPUE) and exploitation levels.

Additionally, both multi-species survey and observer data sets were used in quantifying the impact of the shrimp fishery upon various groundfish.

Orr, D.C., Kulka, D.W., Veitch, P.J., and Firth, J. 2001. Groundfish by-catch within the inshore vessel (<500 ton; <100') shrimp fishery off the east coast of Newfoundland and Labrador during 2000. NAFO SCR documents 01/46: 25 p.

This paper quantifies the by-catch of Atlantic cod (*Gadus morhus*), American plaice (*Hippoglossoides platessoides*), redfish (*Sebastes* spp.) and Greenland halibut (*Reinhardtius hipplglossoides*) within the 2GHJ3KL inshore vessel (<500 ton; <100') northern shrimp (*Pandalus borealis*) fishery which occurred during April - November, 2000. Northern shrimp catches were overlain upon contours of Atlantic cod (TL <+ 19cm), American plaice (TL<+ 16 cm), redfish (TL <+ 18cm) and Greenland halibut (TL<+ 24 cm) abundances. The plots indicated that northern shrimp are distributed along shelf edges, but are mainly in channels and at depths between 200 and 500m. However, Atlantic cod were mainly along the southeastern coast of Labrador, inshore along the Newfoundland coast and upon the Grand Banks. American plaice were common in low abundances throughout the northern shrimp distribution. These factors resulted in relatively small amounts of cod and plaice by-catch. Conversely redfish and Greenland halibut were abundant wherever shrimp were present. Redfish and Greenland halibut length frequencies were available, therefore, it was possible to estimate percent loss at age, and loss of yield estimates for these species.

Orr, D.C., Veitch, P., and Sullivan, D. 2002. An update of information pertaining to northern shrimp (*Pandalus borealis, Koyer)* and groundfish in NAFO divisions 3LNO. NAFO SCR documents 02/160: 55 p.

Since 1995, Canadian multi-species stratified random surveys have been used to estimate northern shrimp (*Pandalus borealis*, Kroyer) biomass and abundances in 3LNO. Biomass indices increased from approximately 6,000 t in 1995 to 224,000 t during autumn 2001, and then decreased to 159,000 t in spring 2002. Data from these surveys were used in age, relative year-class strength and year-class progression determinations. Fishery data were used in determining Catch - Per - Unit - Effort (CPUE) and exploitation levels. Additionally, both multi-species survey and observer data sets were used in quantifying the impact of the shrimp fishery upon various groundfish.

Orr, D.C., Kulka, D., and Firth, J. 2002. Groundfish by-catch in the Canadian small (<500 tons; LOA<100') and large (=>500 tons) vessel Division 3L shrimp fishery, during 2000 and 2001. NAFO SCR documents 02/6: 6 p.

A NAFO regulated shrimp (*Pandalus borealis*) fishery has existed in Division 3L since 2000. Canadian vessels are allowed to catch 5 000 tons of shrimp inside the Exclusive Economic Zone (EEZ) while a 1 000 tons quota has been set for the NAFO Regulatory Area (NRA). This working paper provides estimates of groundfish by catch in the 2000 and 2001 Canadian Div. 3L shrimp fisheries. Groundfish by catch results were estimated for Atlantic cod (*Gadus morhua)*, redfish (*Sebastes* spp.), American plaice (*Hippoglossoides platessoides*) and Greenland halibut (*Reinhardtius hippoglossoides*) during the 2000 and 2001 shrimp fisheries, in Div. 3L.

Orr, D.C., Veitch, P., and Sullivan, D. 2002. Information pertaining to northern shrimp (*Pandalus borealis*) and groundfish in NAFO Divisions 3LNO. NAFO SCR documents 02/61: 72 p.

Since 1995, Canadian multi-species stratified random sruveys have been sued to estimate northern shrimp (*Pandalus borealis*, Kroyer) biomass and abundance indices within NAFO Divisions 3LNO. the geographic distribution of this resource including the relative and seasonal distribution inside and outside the NAFO Regulatory Area (NRA) by both Division and age group are described within this report. Biomass increased from 5,921 tons in autumn 1995 to 121,815 tons in spring 2000 then decreased to 103,451 tons in spring 2001. At least 90% of the resource was found within NAFO Div. 3L. Tighter confidence limits around the point estimates were usually obtained from autumn rather than spring surveys. Autumn estimates indicated that between 12 and 24% of the resource was found in the NRA. Whereas between 18 and 32% of the biomass, estimated from spring survey data, were found in the NRA. Within NRA demographics were similar to those from their respective divisions. The abundance and seasonal distribution of the resource is then described in relation to a proposed Southeast Shoal (Div. 3N) closed area. Northern shrimp were found in the proposed area on only two occasions.

Orr, D.C., Veitch, P., and Sullivan, D. 2003. An update of information pertaining to northern shrimp (*Pandalus borealis, Koyer)* and groundfish in NAFO divisions 3LNO. NAFO SCR documents 03/82: 51 p.

This paper describes the 2003 northern shrimp (*Pandalus borealis*, Koyer) assessment completed for Divisions 3LNO. Status of the resource was inferred by examining trends in commercial catch, catch per unit effort, fishing pattern and size, sex and age compositions of catches. Canadian spring and autumn multi-species stratified random bottom trawl surveys have been used to estimate northern shrimp (*Pandalus borealis*, Kroyer) biomass and abundances in Div. 3LNO. These findings were compared with results from previous surveys. Biomass and abundance of shrimp increased significantly since 1999 and remained broadly distributed over the study area. Consequently catch rates by Canadian and international shrimp fishing fleets remained stable or have increased since the fishery began in 2000. The shrimp resource within Div. 3LNO is currently healthy with high abundances of males and females. The strong 1997-1999 year-classes should support the fishery over the next few years. Both multi-species survey and observer datasets were used in quantifying the potential impact of the shrimp fishery upon various commercially important groundfish species.

Orr, D.C., Veitch, P., and Sullivan, D.J. 2004. An update of information pertaining to northern shrimp (*Pandalus borealis, Koyer)* and groundfish in NAFO divisions 3LNO. NAFO SCR documents 04/86: 45 p.

This paper describes the 2004 northern shrimp (*Pandalus borealis*, Kroyer) assessment completed for NAFO Div. 3LNO. Status of the resource was inferred by examining trends in commercial catch, catch per unit effort, fishing pattern and size, sex and age compositions of catches. Canadian spring and autumn multi-species stratified random bottom trawl surveys have been used to estimate northern shrimp (*Pandalus borealis*, Kroyer) biomass and abundances in Div. 3LNO. These findings were compared with results from previous surveys. Biomass and abundance of shrimp increased significantly since 1999 and remained broadly distributed over the study area. Consequently catch rates by Canadian and international shrimp fishing fleets remained stable or have increased since the fishery began in 2000. The shrimp resource within Div. 3LNO is currently healthy with high abundances of males and females that should support the fishery over the next few years. Both multi-species survey and observer datasets were used in quantifying the potential impact of the shrimp fishery upon various commercially important groundfish species.

Osborne, D.R., Treble, M., Dueck, L., and Cosens, S. 2005. Canadian research report for 2004. Part I, Newfoundland and Labrador Regional Subareas 0 and 1. Part II, Central and Arctic Region. NAFO SCS documents 05/12: 33 p.

Osorio, C.R., Barja, J.L., Hutson, R.A., and Collins, M.D. 1999. *Arthrobacter rhombi sp. nov.*, isolated from Greenland halibut (*Reinhardtius hippoglossoides*). Int. J. Syst. Bacteriol.

49: 1217-1220.

Two strains of a hitherto undescribed Gram-positive coryneform bacterium isolated from Greenland halibut (*Reinhardtius hippoglossoides*) were characterized by phenotypic and molecular taxonomic methods. Comparative 16S rRNA gene sequencing studies demonstrated that the unknown strains constitute a new line within the genus Arthrobacter. The nearest relatives of the bacterium from fish were members of the *Arthrobacter nicotianae*/ *Arthrobacter sulfureus* group. The unknown bacterium was readily distinguished from these species by phenotypic methods. Based on phylogenetic and phenotypic evidence, it is proposed that the unknown bacterium be classified as *Arthrobacter rhombi* sp. nov. The type strain of *Arthrobacter rhombi* is CCUG 38813(T).

Osterhaug, K.L. and Kerr, R.G. 1959. How to cook halibut. Fish and Wildlife Service, Washington, D.C. 10 p.

Ostermeyer, U. 1999. Vitamine in Fischen [Vitamins in fish]. Inf. Fischwirtsch. Fischereiforsch 46: 42-50.
[In German, English summary]

Vitamins are organic substances which are present in minute amounts in natural foodstuffs and which are essential for normal physiological functions. The short review gives an overview on the vitamin content in fish and discusses the influence of industrial production and household cooking. The vitamin contents in fish depend on the species and vary considerably. Fish is a rich source of vitamin D and B,2. Some species contain also considerable amounts of niacin, vitamin B6 and vitamin E.

Ouellet, G. and Paul, M. 1984. Donnees sur le stade de developpement des gonades du flétan du Groenland en hiver dans le golfe du Saint-Laurent. Document de recherche (Québec (Province). Sous-ministeriat aux pêches maritimes. Direction de la recherche scientifique et technique) 84/23, 9 p.
[In French]

Ouellet, P. 1985. Synopsis de la littérature sur l' échantillonnage et le contrôle des populations de larves de poisson: présentation d' autre cas: le hareng (*Clupea harengus harengus*), la morue (*Gadus morhua*), le turbot (*Reinhardtius hippoglossoides*) et un invertébré, la crevette (*Pandalus borealis*). Canada. Direction de la recherche sur les pêches. Région du Québec; Canada. Ministère des pêches et des océans, Québec. 165 p.
[In French]

Palsson, O.K. 1997. Predator-prey interactions of demersal fish species and capelin (*Mallotus villosus)* in Icelandic waters. *In* Forage fishes in marine ecosystems : proceedings of the International Symposium on the Role of Forage Fishes in Marine Ecosytems. University of Alaska Fairbanks, Fairbanks, Alaska. Alaska Sea Grant College Program report; AK-SG-97-01; Lowell Wakefield fisheries symposia series; 14.pp. 105-126.

Extensive sampling of material on the food and feeding of demersal fish species in Icelandic waters was carried out in March, July, and November-December 1992. Based on this material the role of capelin (*Mallotus villosus*) as prey of nine demersal fish species is analyzed: Atlantic cod (*Gadus morhua*), haddock (*Melanogrammus aeglefinus*), pollock (*Pollachius virens*), European whiting (*Merlangius merlangus*), Atlantic wolffish (*Anarhichas lupus*), spotted wolffish *(A. minor*), Greenland halibut (*Reinhardtius hippoglossoides*), American plaice (*Hippoglossoides platessoides*), and thorny skate (*Raja radiata*). The results indicate a large amount of seasonality in the consumption of capelin, with highest consumption by all predator species in March, which coincides with the spawning period of capelin. Only few predators, in particular the Atlantic cod and Greenland halibut, are found to prey significantly on capelin in other seasons. As a rule,

predation on capelin rapidly increases with predator length and may decrease again among the largest predator length groups. Capelin of all size groups are preyed upon, although the largest, sexually mature fish are more frequently eaten. The calculated predation by all predators in March amounts to 270,000 metric tons, of which Atlantic cod consume 56%. Pollock consume similar amounts of capelin per individual fish, but markedly less on a stock basis due to lesser stock size, or 25%. Although consumption by other predators is rather insignificant in relation to that of Atlantic cod and pollock, it adds up to 50,000 tons over a period of 1 month. The calculated size of the spawning stock of capelin at spawning time in March 1992, based on acoustic measurements, was 475,000 tons. Thus, the calculated consumption by the nine predators amounts to 57% of the spawning stock. It is suggested that predatory impact of this order needs to be incorporated in stock projections and management considerations.

Parmiter, D., Treble, M., and Cosens, S. 2001. Canadian research report for 2000 : Part I. Newfoundland Region, Part II. Central and Arctic Region. NAFO SCS documents 01/15: 15 p.

Parsons, D.G. 2005. Interactions between northern shrimp, *Pandalus borealis* (Pandalidae), and its key predators within the eastern Newfoundland and Labrador marine ecosystem. Mar. Biol. Res. 1: 59-67.

An examination of population trends for northern shrimp (*Pandalus borealis*) and its key predators off eastern Newfoundland and Labrador provided the basis for investigating predator - prey relationships within an ecosystem that experienced major changes in species composition during the 1980s and 1990s. Populations of several demersal fish species, known to feed on northern shrimp, declined to historically low levels by the early 1990s and remained depressed thereafter. Some declines were precipitous from the late 1980s to early 1990s, coincident with an increase in shrimp. Populations of other important predator species increased throughout the 1990s along with shrimp. Lacking representative estimates of shrimp consumption, the net effect on predation mortality was unquantifiable and it was not possible to demonstrate with certainty that the major increase in shrimp biomass that occurred throughout the 1990s resulted from a concomitant reduction in predation mortality. Factors (and their interactions) relevant to the dynamics of shrimp populations include the effects of ocean climate, predation, competition, as well as commercial harvesting.

Parsons, D.G. and Khan, R.A. 1986. Microsporidiosis in the northern shrimp *Pandalus borealis*. J. Invertebr. Pathol. 47: 74-81.

Northern shrimp (*Pandalus borealis*) with opaque skeletal musculature were observed in trawl samples taken off the coast of Labrador in the northwestern Atlantic Ocean. The causative agent, a microsporidian parasite, is considered to be a species of the collective group, Microsporidium. Lesions were restricted to striated muscle in which spores occurred as clusters. Prevalence of the parasite was low (0.04% of 180,886 specimens examined) and infections were observed in both sexes and transitional stages. Reproductive potential of most infected animals was reduced. Its mode of transmission is unknown, although it is possible that Greenland halibut (*Reinhardtius hippoglossoides*) and/or Atlantic cod (*Gadus morhua*), major shrimp predators, act as intermediate or conditioning hosts.

Parsons, D.G. and Veitch, P.J. 1985. Results of a survey for shrimp (*Pandalus borealis*) in Division 3K, July 1984. CAFSAC Res. Doc. 85/18: 16 p.

Parsons, L.S. 1986. Canadian request for scientific advice on management in 1987 of certain stocks in Subareas 0 to 4. NAFO SCS documents 86/6: 1 p.

Parsons, L.S. 1987. Canadian request for scientific advice on management in 1988 of certain stocks in Subareas 0 to 4. NAFO SCS documents 87/04: 1 p.

Paschen, U. 1969. Results of some studies on the Greenland halibut (*Reinhardtius hippoglossoides*) near Iceland in 1967. Can. Transl. Fish. Aquat. Sci. 1216: 24 p. [Translated from German; Original appeared in Fischerei-Forschung. Wissenschaftliche Schriftenreihe. 6(1): 29-36, 1968]

In April/May and September 1967 the Institute for Deep-Sea Fishing and Fish Processing carried out studies near Iceland with the aim of exploring the possibilities of catching Greenland halibut in that area. The results of these studies revealed that the halibut caught in April/May off north-western Iceland were mostly fish in the post-spawning stage. The studies in September indicated that the regions off northern and eastern Iceland were presumably the feeding and breeding grounds of the Iceland halibut. The findings of both journeys led to the assumption that all halibut found in the regions off north-western, northern and eastern Iceland belong to the same stock.

Patterson, K.R. and de Cárdenas, E. 2000. Evaluation of Greenland halibut dynamics in 2J3KLMNO using separable models in Bayes and maximum-likelihood approaches. NAFO SCR documents 00/17: 59 p.

The problem of estimating stock dynamics parameters is addressed with partial information on catches at age. Models are used assuming separability of fishing mortality by year and by age, and apply these in either maximum-likelihood or Bayes statistical frameworks incorporating a random walk in fishing mortality. Three approaches are used in estimating selection parameters, either assuming these are fixed parameters estimable from selectivity experiments, or estimating them from either Canadian or total international catches at age for the years in which these data are available. Results are generally similar, indicating that fishing mortality increased about threefold during the early 1990s but has returned to approximately its previous level since 1994. Biomass declined from 1978 until about 1994 and increased afterwards, concomitant with an increase in recuitment since 1994. Corresponding forecasts of F-status quo catches in 2001 range from 30 000t to 55 000 t.

Paulsen, J. 1991. Denmark (Greenland) request for scientific advice on management of certain stocks in 1991. NAFO SCS documents 90/04: 2 p.

Paulsen, J. 1992. Denmark (Greenland) request for scientific advice on management of certain stocks in 1993. NAFO SCS documents 92/3: 2 p.

Pavlov, V.A. 2001. By-catch of snow crab of the genus *Chionecetes* in Greenland halibut fishery in Division 3L in 2000. NAFO SCR documents 01/11: 4 p.

Data relating to by-catch of snow crab (genus *Chionoecetes*), its size composition and distribution by depth, collected by a commercial vessel from 23 February to 16 May 2000 are presented.

Paz, J. and Casas, J.M. 1995. Zonation and associations of dominant fish fauna on Flemish Cap. NAFO SCR documents 95/45: 12 p.

Data from 682 demersal trawls between 126 and 738 m were made on Flemish Cap in summer during the research surveys in the years 1989-1994. Despite the fact that the depth range for all species was not completely covered, analysis of the vertical distribution of the 25 most representative species showed that the fauna is zoned with depth. Distinct faunal assemblages with characteristic catch rates, diversity, and dominant species are found on the shelf (126-130 m), upper continental slope (300-600 m) and middle continental slope (>600 m). Catch rates are greatest on the shelf and upper continental slope, as while as diversity is greatest on the middle continental slope. Dominance of the commercial species (cod, redfish, American plaice, Greenland halibut) is an important aspect of the community structure. Diversity patterns may be understood in terms of the relationships with predation, competition, environmental heterogeneity, and trophic level. Also the influence of the fisheries in the area can modify this structure.

Paz, J. and Casas, J.M. 1996. Zonation and associations of dominant fish fauna on Flemish Cap. Northwest Atl. Fish. Organ. Sci. Counc. Stud. 25: 67-75.

Data were obtained from 682 demersal trawls made between 126 and 738 m depths on Flemish Cap in summer during the European Union research surveys in the years 1989-94. Despite the fact that the depth range for all species was not completely covered, analysis of different deep distributions of the 25 most representative species showed that the fauna are zoned with depth. Three faunal assemblages with characteristic catch rates, diversity and dominant species were found on the shelf (126-300 m), upper continental slope (300-600 m) and middle continental slope (gt 600 m). Catch rates were greatest on the shelf and upper continental slope, while diversity was greatest on the middle continental slope. Dominance of the commercial species Atlantic cod (*Gadus morhua*), golden redfish (*Sebastes marinus*) and American plaice (*Hippoglossoides platessoides*) on the shelf, beaked redfish (*Sebastes mentella)* and Labrador redfish (*Sebastes fasciatus*) on upper continental slope, and Greenland halibut (*Reinhardtius hippoglossoides*) on the middle continental slope. This showed an important aspect of the community structure. Diversity patterns may be understood in terms of the relationships with predation, competition, environmental heterogeneity and trophic level. Also the influence of the fisheries in the area can modify this structure. On the size-depth correlations, only longnose eel (*Synaphobranchus kaupy*), longfin hake (*Urophycis chestery*), Atlantic cod (*Gadus morhua)*, beaked redfish (*Sebastes mentella)*, golden redfish (*Sebastes marinus*) and Greenland halibut (*Reinhardtius hippoglossoides*) showed a significant 'bigger-deeper' relationship (i.e. larger fish in deeper strata), while spotted wolffish (*Anarhichas minor*) and witch flounder (*Glyptocephalus cynoglossus*) showed a negative 'smaller-deeper' relationship.

Paz, J. and Iglesias, S. 1994. Grenadiers in the Spanish fishery of Greenland halibut, NAFO Divisions 3LM and 3N, 1991-1993. NAFO SCR documents 94/23: 10 p.

In the Spanish Greenland halibut (*Reinhardtius hippoglossoides)* Fishery, grenadier Macrouridae are an important component in the by-catch. Their catch, catch-rate and size distribution were analyzed during the period 1991 to 1993. The importance of these species in relation to the target species increased in the period studied and the proportion between the two in by-catch was approximately 50%. Yields were greater during the first half year period, and increased with depth. Sizes of roundnose were smaller to the south (3N) whereas roughhead sizes were larger in this same division.

Paz, J., Martinez, J., and de Cárdenas, E. 1995. Preliminary results from the 95 Spanish bottom trawl survey in the NAFO regulatory area for the Divisions 3NO. NAFO SCR documents 95/55: 10 p.

Paz, J., Duran, P., and de Cárdenas, E. 1996. Preliminary results from the 96 Spanish bottom trawl survey in the NAFO regulatory area for the Divisions 3NO. NAFO SCR documents 96/49: 12 p.

A stratified-random bottom trawl survey, which covered offshore areas on the Grand Bank, was conducted following the same procedures and the same vessel gear of the 1995 survey. To compare the results obtained in this survey with those obtained in 1995, changes in biomass and distribution were analyzed for 5 species: American plaice,(*Hippoglossoides platessoides*), yellowtail flounder, (*Pleuronectes ferrugineus*), Greenland halibut, (*Reinhardtius hippoglossoides*), witch flounder, (*Glytocephalus cynoglossus*) and northern cod (*Gadus morhua).*

Paz, J., Duran, P., and de Cárdenas, E. 1997. Preliminary results from the 1997 bottom trawl survey in the NAFO regulatory area for Divisions 3NO. NAFO SCR documents 97/25 (rev.): 13 p.

A stratified-random trawl survey was performed in NAFO Regulatory Area (Division 3NO) from 26th April to 17th May. the survey, which covered offshore areas on the Grand Bank, was conducted following the same procedures and the same vessel and gear of the 1995 and 1996 surveys. In 1997, the area covered was extended until 700 fathoms including the following new strat: 754, 758, 762 and 766. A total of 128 valid fishing sets were completed, 106 of them in Div. 3N and 22 in Div. 3O. At touchdown of the net, a standard 30 minutes tow started, at a mean speed of 3 knots. Trawls with net damage were excluded from the analysis. From each set, catch numbers and weights for the main species along with length frequency from American plaice, *Hippoglossoides platessoides,* yellowtail flounder, *Pleuronectes ferrugineus*, Greenland halibut, *Reinhardtius hippoglossoides*, witch flounder, *Glyptocephalus cynoglossus,* and Atlantic cod, *Gadus morhua* are presented. The American plaice, yellowtail flounder and cod catches are decreasing.

Paz, X. and Duran, P. 1999. Results from the 99 Spanish bottom trawl survey in the regulatory area for Divisions 3NO. NAFO SCR documents 99/57: 23 p.

As in previous years a stratified-random bottom trawl survey was performed in NAFO Regulatory Area (Divisions 3NO) during 7th to 28th May. The survey, which covered offshore areas on the Grand Bank, was conducted following the same procedures and the same vessel and gear of the 1995-98 surveys. The area and strata to be covered by the survey were based on the stratification charts and tables in Bishop (1994). In 1999, the area covered was extended until 800 fathoms including the new strate: 755, 759, 763, 767. A total of 117 successful fishing sets were completed and 17 other tows were preformed with the Campelen net.

Paz, X., Román, E., and Duran Munoz, P. 2000. Results from the 2000 Spanish bottom trawl survey in the NAFO regulatory area for Divisions 3NO. NAFO SCR documents 00/46: 18 p.

Since 1995 the Spanish spring bottom trawl survey was conducted in NAFO Regulatory Area (Div. 3NO) during May. the main purpose of the surveys was to obtain abundance and biomass indices for the commercial species: American plaice, yellowtail flounder, thorny skate, Greenland halibut, cod and witch flounder. The stratified-random sampling method of set selection was used. The area covered was extended until 800 fathoms. A total of 137 successful fishing sets wree completed including 13 sets performed with the net Campelen also.

Paz, X., Gonzalez Troncoso, D., and Duran Munoz, P. 2002. Comparative exercise of efficiency between C/V Playa de Menduina and R/V Vizconde de Eza in the NAFO Divisions 3NO in May 2001. NAFO SCR documents 02/5: 25 p.

In 2002 the R/V Vizconde de Eza will replace the C/V Playa de Menduíña in conducting the Platuxa bottom trawl series carried out by the Centro Oceanográfico de Vigo (Oceanographic Center of Vigo) since 1995. In May of 2001 a comparative fishing experience was conducted to transform the series of the indices previously obtained and maintain the continuity of the time series obtained by the C/V Playa de Menduíña. A 81 parallel hauls series was performed. For each of the main species: American Plaice, Yellowtail flounder, Cod, Witch flounder and Thorny skate, the catches of both vessels were compared and a linear fit for these catches is presented. Also, we performed a comparative study on the catches by length for American plaice and Yellowtail flounder by a probability variant of the logistic curve, assuming unequal catches between the two vessels, and a fit to transformed these data. As anticipated, the values of the new indices were lower than the previous values, because the Pedreira is approximately four times more efficient than the Campelen trawl gear.

Pedersen, P.M. 1999. Denmark (Greenland) request for scientific advice on management of certain stocks in Subareas 0 and 1. NAFO SCS documents 99/2: 1 p.

Pedersen, S.A. 1989. Denmark (Greenland) research report for 1988. NAFO SCS documents 89/14: 9 p.

Pedersen, S.A. 1990. Denmark/Greenland research report for 1989. NAFO SCS documents 90/14: 8 p.

The present study indicates that redfish, Greenland halibut and starry ray feed throughout the 24-hour cycle with no clear diel feeding rhythms.

Pedersen, S.A. 1994. Shrimp trawl catches and stomach contents of redfish, Greenland halibut and starry ray from West Greenland during a 24-hour cycle. Polar Res. 13: 183-196.

A total of 179 redfish (*Sebastes* spp.), 495 Greenland halibut (*Reinhardtius hippoglossoides*) and 133 starry ray (*Raja radiata*) stomachs were collected from the catch in four bottom trawl hauls carried out at 6-hour intervals on a shrimp fishing ground off West Greenland in September 1991. Between 90 and 96% of the total catch in each of the four trawl hauls consisted of northern shrimp (*Pandalus borealis*). The fish catches were small and dominated by redfish, Greenland halibut, starry ray and polar cod (*Boreogadus saida*). The stomach contents of redfish consisted of crustaceans (mysiids, hyperiids and copepods) followed by cephalopods, northern shrimp and redfish. Fish (mainly redfish), cephalopods and northern shrimp were the most important stomach content of Greenland halibut. The stomach content of starry ray consisted mainly of northern shrimp and redfish. Plots of redfish and shrimp sizes found in the stomachs of Greenland halibut and starry ray versus predator size showed only weak associations indicating that availability overruled the importance of size-dependent prey preference.

Pedersen, S.A. and Kanneworff, P. 1995. Fish on the West Greenland shrimp grounds, 1988-1992. ICES J. Mar. Sci. 52: 165-182.

Analysis of catch data from five bottom trawl surveys in West Greenland waters (1988-1992) documents coincidence between shrimp and important nursery grounds for a number of fish species, especially redfish (*Sebastes* spp.), Greenland halibut (*Reinhardtius hippoglossoides*), Atlantic cod (*Gadus morhua*), and polar cod (*Boregadus saida*). The estimated overall combined trawlable shrimp and fish biomasses showed no clear trends between years. However, redfish, Greenland halibut and Atlantic cod showed large fluctuations due to variability in year-class strength. In 1992 the fish catches were identified to 64 taxonomic units (49 species). Boreal fish species occurred most frequently in the hauls in the southern part of the survey area. There were a decreasing trend in the CPUEs of boreal species from 1988 to 1992. It is concluded that the West Greenland shrimp grounds can be considered as fish assemblage areas appropriate for studying the effects of the shrimp fishery on the shrimp and fish populations as well as the dynamics between these resources.

Pedersen, S.A. and Lehmann, K. 1989. By-catch of redfish and Greenland halibut in the shrimp fishery off West Greenland, 1988. NAFO SCR documents 89/41: 12 p.

This paper provides information on the by-catch of redfish and Greenland halibut during a stratified-random shrimp survey with a commercial shrimp trawler in July, 1988. Biomass and abundance estimates for the by-catch species in the survey area were calculated. An estimate of the total by-catch of redfish and Greenland halibut in the shrimp fishery off West Greenland in 1988 is given. The by-catch is compared with earlier by-catch investigations in Subarea 1 and with the by-catch in 1988 as stated by the commercial Greenland shrimp trawlers.

Pedersen, S.A. and Nygard, K.H. 1992. Survey biomass of fishes in the Disko Bay area west Greenland - September 1991. NAFO SCR documents 92/43: 9 p.

A stratified-random shrimp trawl survey was conducted in September 1991 in the inshore areas of Disko Bay and Vaigat off West Greenland, NAFO Division 1A (Fig. 1). This survey was an extension of the 1991 offshore shrimp trawl survey initiated in July 1988 by Greenland Fisheries Research Institute (Carlsson and Kanneworff, 1991). The scope of the survey was to assess the trawlable biomass of shrimps and the by-caught fish species, and to collect inshore shrimp stock component and the by-caught fish species. This paper presents estimates of biomass and size frequency distributions of the most important fish species by- caught during the survey.

Pedersen, S.A. and Riget, F. 1991. Preliminary studies on feeding habits of demersal fish species in West Greenland waters with special emphasis on predation on shrimp. NAFO SCR documents 91/47: 12 p.

In order to study the importance and level of predation on the shrimp stock by fish a sampling program for stomachs from the key fish species on the shrimp grounds was started in 1990. This paper presents preliminary results from investigations of the stomach content of seven demersal fish species: Redfish (*Sebastes* spp.), Greenland halibut (*Reinhardtius hippoglossoides*), Long roug dab (*Hippoglossoides platessoides*), Skates (*Raja* spp.), Atlantic halibut (*Hippoglossus hippoglossus*), Eelpout (*Lycodes* spp.), and Atlantic wolffish (*Anachrichas lupus*). A more detailed examination of food compositions of redfish and Greenland halibut are presented and discussed in Pedersen and Riget (1991) and Riget and Pedersen (1991).

Pedersen, S.A. and Riget, F. 1992. Feeding habits of Greenland halibut, *Reinhardtius hippoglossoides*, in West Greenland waters with special emphasis on predation on shrimp and juvenile redfish. ICES CM 1992/G:25: 22 p.

A total of 3,030 Greenland halibut stomachs were collected in summer and autumn 1990-91 and in winter and spring 1992. The composition of Greenland halibut stomach content shows strong similarity among sampling periods. Redfish, *Sebastes* sp., was by far the most dominating fish species contributing 17 to 48% of the total prey weight. Northern shrimp, *Pandalus borealis*, was the dominating crustacean in the stomachs and was found in all sampling periods. Shrimp contributed 21 to 43% of the total prey weight. No influence of prey size preference of Greenland halibut for shrimp and redfish was found. There was no influence of predator size and sampling period on the average degree of stomach fullness. The daily ration (% of body weight per day) of Greenland halibut was calculated to 0.92 (%BWD) for the autumn- winter period and to 0.54 (%BWD) for the spring-summer period using an exponential gastric evacuation rate model. The annual consumption of redfish as calculated to 2,900 tons and 5,100 tons for 1990 and 1991, respectively and the consumption of shrimp to 1,300 tons for 1990 and 1,100 tons for 1991. We conclude that the estimated annual consumption of shrimp and redfish seems to have a minor impact on the shrimp stock, but a significant impact on the redfish stock.

Pedersen, S.A. and Riget, F. 1993. Feeding habits of redfish (*Sebastes* spp.) and Greenland halibut (*Reinhardtius hippoglossoides*) in West Greenland waters. ICES J. Mar. Sci. 50: 445-459.

A total of 2708 redfish and 3030 Greenland halibut stomachs were collected on the shrimp fishing grounds off West Greenland in summer and autumn 1990-1991 and in winter and spring 1992. The stomach contents of small redfish (5-19 cm) and small Greenland halibut (lt 14 cm) were dominated by planktonic crustaceans. Hyperiids (*Parathemisto* sp.) were the dominant prey in summer and autumn, copepods in winter, and euphausiids in spring. For larger redfish (gt 20 cm) and larger Greenland halibut (gt 14 cm), northern shrimp (*Pandalus borealis*) and juvenile redfish were important prey. Predator size and sampling period were found to influence the average degree of stomach fullness for redfish, but not for Greenland halibut. No influence of prey size preference of Greenland halibut for shrimp and redfish was found. Redfish was found to be the most important prey and shrimp the second most important prey in the diet of Greenland halibut. This study indicates that redfish is an important predator of shrimp, whereas Greenland halibut is an important predator of both redfish and shrimp.

Pedersen, S.A. and Zeller, D. 2001. A mass balance model for the West Greenland marine ecosystem. *In* Fisheries impacts on North Atlantic ecosystems: models and analyses. *Edited by* S.Guenette, V.Christensen, and D.Pauly. The Fisheries Centre, University of British Columbia, Vancouver, B.C. pp. 111-127.

The paper reviews the available information on fisheries, community structure and trophic relationships in the West Greenland marine ecosystem. In an attempt to evaluate the relationships between the dominant species and fisheries, a mass balance model using the Ecopath approach was constructed for the West Greenland shelf for 1997. Commercially important fish species for West Greenland include; cod (*Gadus morhua*), redfish (*Sebastes marinus*), Atlantic halibut (*Hippoglossus hippoglossus*), and wolffish (*Anarhichas lupus, Anarhichas minor*), Greenland halibut (*Reinhardtius hippoglossoides*) and northern shrimp (*Pandalus borealis*). The present report outlines the input data used to obtain a balanced Ecopath model, forming the foundation for future simulations.

Pelletier, É., Canuel, G., Padros, J., Clermont, Y., and Gobeil, C. 1999. Concentrations d'hydrocarbures aromatiques polycycliques chez quatre espèces de poissons de fond et deux espèces de crustacés de l'estuaire et du golfe du Saint-Laurent et du fjord du Saguenay [Levels of polycyclic aromatic hydrocarbons in four deep water fish and two crustacean species in the Estuary and Gulf of St. Lawrence and the Saguenay Fjord]. Can. Data Rep. Fish. Aquat. Sci. 1052: 25 p.
[In French]

This report summarizes work done conjointly by INRS-Oceanologie (Universite du Québec, Rimouski, Québec) and the Maurice Lamontagne Institute (Department of Fisheries and Oceans, Mont-Joli, Quebec) to determine levels of polycyclic aromatic hydrocarbons (PAHs) in Atlantic cod (*Gadus morhua*), American plaice (*Hippoglossoides platessoides*), thorny skate (*Raja radiata)*, Greenland halibut (*Reinhardtius hippoglossoides*), and northern shrimp (*Pandalus borealis*) from the Estuary and Gulf of St. Lawrence as well as in snow crab (*Chionoecetes opilio*) from the St. Lawrence Estuary and the Saguenay Fjord. The specific compounds that we tried to detect were fluoranthene, pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(a)pyrene, dibenzo(a,h)anthracene, benzo(g,h,i)perylene, naphtalene, acenaphtene, fluorene, phenanthrene, and anthracene. Concentrations of all PAHs in the muscle tissue of cod (n=12), plaice (n=12), skate (n=6), and halibut (n=6) were below the analytical detection limits. With the exception of benzo(a)anthracene, concentrations of PAHs were also below detection limits in halibut liver tissue (n=9) and crab hepatopancreas (n=9). In contrast, shrimp muscle (n=12) contained measurable levels of fluoranthene, pyrene,

benzo(a)anthracene, phenanthrene, and anthracene. The presence of benzo(a)anthracene in shrimp muscle, halibut liver, and crab hepatopancreas detected by fluorimetry was not confirmed by the mass spectroscopy equipment used due to the very low levels. This study allows us to conclude that the concentrations of PAHs in the analyzed species are always very low, or even non detected, and, consequently, considered safe from a human consumption health point of view.

Perry, G. 2005. Canadian research report for 1997 Newfoundland Region. NAFO SCS documents 98/15: 10 p.

Phu, C. 1993. Market analysis of Greenland halibut and silver hake : work term paper. Canada Fishing Industry Services, Ottawa. 49 p.

Pike, D. 1990. Greenland halibut allocation: Baffin Region. AFSAC background document 89/90-09A: 7 p.

Pike, D.G. 1994. The fishery for Greenland halibut (*Reinhardtius hippoglossoides*) in Cumberland Sound, Baffin Island, 1987-1992. Can. Tech. Rep. Fish. Aquat. Sci. 1924: 24 p.

Catch per unit effort (CPUE) and biological data were collected from the fishery for Greenland halibut (*Reinhardtius hippoglossoides*) in Cumberland Sound from 1987-1992. Catch per unit effort showed no consistent diurnal or seasonal trends within years, but did vary between years. Mean CPUE was lower in 1991 and 1992 than in the earlier years of the fishery. Ninety-seven percent of the fish caught were female, and all were either immature or not in spawning condition. The prevalence of females in the catch may have been a result of gear selectivity. Males were smaller, younger and grew more slowly than females. There were no trends in mean length, mean age, total instantaneous mortality or growth rate of female Greenland halibut that were indicative of possible overexploitation. Management and research recommendations for the Cumberland Sound fishery are outlined.

Pike, D.G. and Mathias, J.A. 1995. Status of the Greenland halibut fishery in Cumberland Sound, Baffin Island. NAFO SCR documents 95/50: 18 p.

A winter longline fishery for Greenland halibut was started in Cumberland Sound Baffin Island in 1987. Fishing takes place between mid-January and the end of May. By 1992 the harvest had risen to just under 400 tons, a level which remained stable from 1992-94. The catch has been monitored each year to the present by means of fishermen's records and a sampling of the catch for length, weight, age and maturity. Catch per unit of fishing effort (CPUE) varied significantly among years, but has not shown any temporal trend during the life of the fishery. Year-to-year variations in CPUE are confounded by changes in fishing location and changes in fishing technology. Ninety-seven percent of Greenland halibut sampled were female, and both males and females were either immature or not in spawning condition. Ripe or spent males or females were not observed. Growth rates of Greenland halibut from Cumberland Sound were similar to those found in Davis Strait. Mean length and weight of fish in the harvest was lower in 1993-1994 than in previous years, but there was no corresponding decrease in age. The dominant age range in the commercial harvest was 9-13 years and did not vary from year-to-year. The major by-catch consisted of Greenland shark and thorny skate. The harvest weight of sharks was often similar to the harvest wieght of Greenland halibut, yet no market has been developed for these fish. The main issue for the halibut fishery at the present is whether the population in Cumberland Sound contributes significantly to the recruitment of fish in Davis Strait or whether it is a largely isolated population, similar to the situation in some of the Greenland Fjords. A scientific program is presently trying to resolve this issue through genetic, morphological and meristic comparisons of Cumberland Sound and Davis Strait populations, and through tagging and distribution studies.

Pitt, T.K. 1971. A report on the tagging of Greenland halibut (*Reinhardtius hippoglossoides*) on the northeast coast of Newfoundland. ICNAF Res. Doc. 71/119: 3 p.

Pitt, T.K. 1974. The Greenland halibut fishery in Subarea 2 and Divisions 3K & 3L. ICNAF Res. Doc. 74/2: 4 p.

Plotitsyna, N.F. and Kireeva, L.I. 1997. Content of pollutants in marine organisms of the Barents Sea. ICES CM 1997/R:4: 12 p.

Liver and muscles of 14 fish species (cod (*Gadus morhua)* haddock (*Melanogrammus aeglefinus*), long rough dab (*Hippoglossoides platessiodes*), deepwater redfish (*Sebastes mentella*), golden redfish (*Sebastes marinus*), skate (*Raja)*, lumpfish *(Cycloptenes lumpus*); Atlantic, northern and spotted wolffish (*Anarhichas*); capelin *(Mallotus villosus*), herring (*Clupea harengus*), Greenland halibut (*Reinhardtius hippoglossoides*) and saithe *(Pollachius virens*)) and muscles of 5 invertebrate species (*Chlamys islandica, Neptuhea despecta, Ciliatocardium ciliatum, Serripes groenlandicus, Paralithodes camtschatica*) were selected for chemical analysis. In fish muscles, the content of n-paraffins varied from 0.7 to 8.5 mkg/g, while in invertebrates it constituted <2 mkg/g wet weight (ww), that corresponds to levels of the content of natural hydrocarbons. In fish liver, the concentrations were higher. The following PAHs predominated in fish muscles: phenanthrene, flioranthene, benz[a]anthracene and benz[b]flouranthene. Benz[a]pyrene was revealed in a small number of samples of cod (0.3-2.9 ng/g ww), haddock (0.2-1.2 ng/g), long rough dab (0.5 ng/g), redfish (0.3-2.4 ng/g), lumpfish (2.7 ng/g) and skate (0.3-4.0 ng/g). The largest content of benz[a]pyrene was revealed in the liver of haddock (up to 8 ng/g ww), cod, halibut and northern wolffish (upto 3 ng/g). In invertebrates the summerized content of PAHs varied from 2.4 to 11.3 ng/g ww. Low concentrations of Ni, Cr, Co, Cd and Hg were revealed in muscles of fish and invertebrates. Large variations of the content of heavy metals were revealed in the liver in dependence on species of fish. The summerized content of organochlorine pesticides (OPC) and PCBs in fish muscles varied from 2.0 to 42.9 ng/g and from 0.6 to 58.3 ng/g ww, correspondingly. Concentrations of pesticides and PCBs in fish liver varied in a wide range from 42 to 624 ng/g and from 45 to 916 ng/g ww, correspondingly.

Podoskina, T.A. 1993. Morphology of supporting elements in jaw-pharyngeal apparatus of some pleuronectiform fishes in relation to feeding specializations. J.Ichthyol. 33: 122-128.

The primary types of feeding by flatfishes are predation and benthophagy. The Black Sea brill, *Psetta maeotica,* and the black halibut, *Reinhardtius hippoglossoides hippoglossoides*, are typical predators (Milinskii, 1944; Il'in, 1949; Konstantinov, 1976). The other species studied are typically benthophagous. The Arctic flounder feeds mainly on small mollusks (Episov, 1949a; Baranenkova, 1952a). In the diet of the White Sea river flounder, *Platichthys flexus bogdanovi*, aquatic insects and small fish play an important role in addition to mollusks (Bulycheva, 1948; Esipov, 1949b; Baranenkova, 1952b; Shatunovskii, 1963). The basis of the diet of the common dab, *Limanda limanda*, is polychaete worms, echinoderms and crustaceans (Bulycheva, 1948; Esipov, 1949c; Baranenkova, 1952c, Otega-Salas, 1980). The sole, *Solea lascaris*, feeds on soft-bodied benthic invertebrates.

Podoskina, T.A. 1993. Morphology of the support elements of the maxillopharyngeal system in some Pleuronectiformes species in connection with their food specialization. Vopr. Ikhtiol. 33: 581-585.
[In Russian]

Podrazhanskaya, S.G. and Chumakov, A.K. 1989. Pitanie, pishchevye ratsiony i pishchevye potrebnosti chernogo paltusa Severo-Zapadnoj Atlantiki [Food habits, diets and demand for food in Greenland halibut of the Northwest Atlantic]. *In* Sutochnye Ritmy I Ratsiony

Pitaniya Promyslovykh Ryb Mirovogo Okeana [Diurnal rhythms and diets of commercial fishes of the world ocean]. *Edited by* S.G.Podrazhanskaya.
[In Russian, English summary]

The paper describes the results of analysis of Greenland halibut stomach contents made by the Polar Fisheries Research Institute. Fish aged 2 to 10 years were sampled in NWA in 1969-1981. The basic food items of the mature part of halibut population found in the north of the area are beaked redfish, roundnose grenadier. In the south the prey are capelin, sandeel, crustaceans, juvenile cod and halibut. The major feeding season is July to November. The maximum feeding intensity occurs at 600-700 m. The natural daily ration varies between 1.2% and 0.4% of the body weight in males aged 5-16, and from 1.2% to 0.8% in females aged 5-20.

Ponomarenko, V.P. 1989. Catches of commercial fish in the Yan-Maien shallow waters Norway in 1974-1975 and 1978. Vopr. Ikhtiol. 29: 658-660.
[In Russian]

The following most widespread fish species caught around Yan-Maien Island were described: *Micromesistius poutassou, Boreogadus saida, Mallotus villosus villosus, Gadus morhua morhua, Melanogrammus aeglefinus, Pollachius virens, Sebastes sp., Reinhardtius hippoglossoides, Hippoglossoides platessoides limandoides, Anarchichas* spp.

Ponomarenko, V.P. 1989. Catches of commercial fishes on the Jan-Mayen shoals in 1974-1975 and 1978. J. Ichthyol. 29: 161-163.

A brief account is given of the composition of trawl catches made during the periods 1974-75 and 1978. *Pandulus borealis, Micromesistius poutassou, Boreogadus saida, Mallotus villosus villosus, Gadus morhua morhua, Melanogrammus aeglefinus , Pollachius virens, Sebastes, Reinhardtius hippoglossoides, Hippoglossoides platessoides limandoides* and *Anarichas* were included in the catches.

Ponomarenko, V.P. 1989. Poimki promyslovykh ryb na Yan-Majenskom melkovod'e v 1974-195 i 1978 [Occurrence of food fishes in the Jan Mayen shallow in 1974-1975 and 1978]. Vopr. Ikhtiol. 29: 658-660.

Based on the analysis of trawl catches characteristic features are presented of *Micromesistius poutassou, Boreogadus saida, Mallotus villosus , Gadus morhua, Melanogrammus aeglefinus, Pollachius virens, Sebastes sp., Reinhardtius hippoglossoides, H. platessoides limandoides* and *Anarhichas sp.*

Ponomarenko, V.P. 1995. Migratsii ryb v Barentsevom more po dannym mecheniya [Migrations of fish in the Barents Sea from tagging data]. Okeanologiya 35: 900-908.
[In Russian, English summary]

Analysis of tag return data on haddock (*Melanogrammus aeglefinus*), coalfish (*Pollachius virens*), Greenland halibut (*Reinhardtius hippoglossoides*), plaice (*Pleuronectes platessa*) and blue sea cat (*Anarhichas denticulatus*) shows changes in their seasonal migrations over the period from the 1930s to 1970s attributed to water cooling.

Portugal, M.L., Ravares, A.M., Dias, M.L., and Godinho, M.L.M. 1976. Portuguese research report, 1975. NAFO SCS documents 76/VI/37: 14 p.

Power, D. 1999. Roundnose grenadier (*Coryphaenoides rupestris*) in NAFO Subareas 2+3. NAFO SCR documents 99/51: 15 p.

Roundnose grenadier (*Coryphaenoides rupestris*) are found throughout Subareas 2 and 3. It is believed that only one stock occupies the entire area including the Regulatory Area although there are different areas of concentration. Catches averaged about 23,000 tons from 1967-1977, about 5,000 tons from 1980-1989, declined rapidly to 800 tons in 1990 and have since been taken as bycatch. The traditional fishery prior to 1990 occurred in Canadian waters in Div. 2GH and 3K. Catches since 1991 have been taken as bycatch primarily in Greenland halibut (*Reinhardtius hippoglossoides*) fisheries in Div. 3LMN. About 50 tons were reported for 1997 and 1998. Surveys have been conducted by various countries; Canada (Div. 2G to Div. 3O) from 1996-98, Japan (Div. 2GH) in 1996 and Russia Div. 2GH from 1987 to 1992 but the time series is of limited value in determining resource status because of limited coverage and various vessel/gears conducting these surveys. This resource is currently under moratorium for directed fishing in the Canadian zone.

Power, D. 2001. Standardized catch rate index for Greenland halibut in SA2+3KLMNO. NAFO SCR documents 01/79: 7 p.

Catch and effort data were analysed with a multiplicative model to derive a standardized catch rate index for Greenland halibut (*Reinhardtius hippoglossoides*) in NAFO SA2+3KLMNO. There were two measures of effort used (hours fished and days fished) in separate analyses because of the lack of hours fished data for EU-Portugal since 1992 and EU-Spain since 1995. The results indicate an increase in recent years from the lowest rates in the time series in 1997. It is uncertain whether the catch rate index is representative of stock abundance because fleets fish in different areas of the stock. The Canadian fleet operates within the 200-mile limit in Div. 3KL while foreign vessels fish in the NAFO Regulatory area outside the 200-mile limit primarily in Div. 3LMN.

Power, D. 2002. Standardized catch rate index for Greenland halibut in SA2+3KLMNO. NAFO SCR documents 02/31: 7 p.

Catch and effort data were analyzed with a multiplicative model to derive a standardized catch rate index for Greenland halibut (*Reinhardtius hippoglossoides*) in NAFO SA2+3KLMNO. There were two measures of effort that were used (hours fished and days fished) in separate analyses because of the lack of hours fished data for some fleets. The results indicate an increase in recent years from the lowest rate in the time series in 1997, which is consistent with improved recruitment. It is uncertain whether the catch rate index is representative of stock abundance because fleets fish in different areas of the stock. The Canadian fleet operates within the 200-mile limit in Div. 3KL while non-Canadian vessels fish in the NAFO Regulatory area outside the 200-mile limit primarily in Div. 3LMN.

Power, D. 2003. Standardized catch rate index for Greenland halibut in SA2+3KLMNO. NAFO SCR documents 03/24: 7 p.

Catch and effort data were analyzed with a multiplicative model to derive a standardized catch rate index for Greenland halibut in NAFO SA2+3KLMNO. Two measures of effort were used (hours fished and days fished) in separate analyses because of the lack of hours fished data for some fleets. The results indicate the lowest catch rate in the time series was experienced in 1997 for hours fished and 1998 for days fished. The hours fished and days fished indices increased to 10 and 15 year highs respectively by 2000, consistent with improved recruitment, but have since declined to their former low levels. It is uncertain whether the catch rate index is representative of stock abundance because fleets fish in different areas of the stock. The Canadian fleet operates within the 200-mile limit in Div. 2J+3KL while foreign vessels fish in the NAFO Regulatory area outside the 200-mile limit primarily in Div. 3LMN.

Power, D. 2004. Standardized catch rate index for Greenland halibut in SA2+3KLMNO. NAFO SCR documents 04/37: 15 p.

Abundance and biomass indices of Grand Bank yellowtail flounder in NAFO Divisions 3LNO were derived from annual multi-species, stratified-random bottom trawl surveys conducted by Canada during the spring of 1984-2003 and during the fall from 1990 to 2003. The majority of the stock is found in depths less than 93 m and in Div. 3NO. After declining in stock size and geographical range from the mid-1980s to the mid-1990s, recent surveys have indicated that the stock size has increased dramatically and has again expanded northward to re-occupy habitats on the northern Grand Bank. The 2003 spring estimate of biomass is the highest in the time series and the fall estimate is the second highest; the average of both is 378,000 tons (1.3 billion fish).

Preikshot, D. 2001. Observation and inspection data: determining catch and bycatch by foreign fisheries on the Grand Bank outside the Canadian EEZ. *In* Fisheries impacts on North Atlantic ecosystems: catch, effort and national/regional data sets. *Edited by* D.Zeller, R.Watson, and D.Pauly. University of British Columbia. Fisheries Centre, Vancouver, B.C. pp. 240-248.

The purpose of this project was to assess if the 'Foreign Fisheries Information Service/Canadian Fisheries Information Network' (FFIS /CFIN) databases on foreign fishing vessels in Northwest Atlantic waters, maintained by the Canadian Department of Fisheries and Oceans (DFO), could yield information that might permit the creation of an index of fish extractions from areas outside of the Canadian Exclusive Economic Zone (EEZ) around the Grand Bank. The major species targeted in the 1990's is turbot, i.e., Greenland halibut (*Reinhardtius hippogloassoides*), which is the only species with a NAFO quota for the area concerned in this project. Grenadiers (*Macrourus berglax* and *Coryphaenoides rupestris*), hake (*Merluccius bilinearis* and *Urophycis chuss*), redfish (*Sebastes* spp.), and skates (*Raja* spp.) are secondary species also caught. To facilitate this work, staff from DFO (St. John's, Newfoundland) provided consulting services on the history of the fisheries, the purpose and contents of the databases, and the actual exploration of the data itself. FFIS and CFIN are now an integrated database that links information collected by various observation platforms, including the Canadian Coast Guard and DFO Patrols, with Northwest Atlantic Fisheries Organization (NAFO) and Canadian inspections of fishing vessels off Canada's coast. The database contains a large number of variables, not all of which are reported on at all times. The data sets that have been collected for the 'Sea Around Us' project are described here. In addition, a method is suggested for linking and integrating the datasets, to allow the building of a new dataset of actual extractions by foreign fishing vessels outside of Canada's territorial waters. This report represents only a preliminary investigation of the use of observation and inspection data.

Priebe, K. 1970. A case of red staining of the body musculature salmon staining of a Greenland halibut *Reinhardtius hippoglossoides*. Berl. Muench Tieraerztl. Wochenschr. 83: 153-154.

Priebe, K. and Reichstein, K. 1975. Observations and investigations on consistency defects in smoked Greenland halibut. Arch. fuer Lebensmittelhygiene 26: 121-128.
[In German, English summary]

Punzon, A., Herrera, M.A., and Delter, H. 1998. Feeding of *Cetroscyllium fabricci* (Reinhardt, 1825) and the influence of the fishery on its diet in Flemish Pass (NAFO Divisons 3LM). NAFO SCR documents 98/34: 11 p.

In 1992 151 stomach containing food of *Centroscyllium fabricci* were analysed on board freezer vessels targeting the Greenland halibut (*Reinhardtius hippoglossoides*) fishery in NAFO Divisions 3LM. Three length groups were established to study variations in diet with length. The most important preys were waste products from fish processing of species caught by the fleet and fish. It was observed that diet varies with length, the smaller specimens feeding on crustaceans and molluscs, offal and fish appearing as prey more and more as length increases, to become the main preys in larger predators.

Québec (Province). Ministère de l'Agriculture, des pêcheries et de l'alimentation. 1990. Le flétan du Groenland. Ministère de l'Agriculture, des pêcheries et de l'alimentation, Québec, Québec.
[In French]

Québec (Province). Ministère de l'Agriculture, des pêcheries et de l'alimentation. 1990. The Greenland halibut. Québec (Province) Ministère de l'Agriculture, des pêcheries et de l'alimentation.

Quero, J.C., Du Buit, M.H., Fonteneau, J., Morandeau, G., and Vayne, J.J. 1993. Observations ichtyologiques effectuées en 1992 [Catch data and new records for the year 1992 in the French Atlantic harbours.]. Ann. Soc. Sci. Nat. Charente-Marit. 8: 119-125.
[In French, English summary]

The authors give data on the catches during 1992 of some rare fishes in the French harbours. Some fishes are recorded for the first time: A*pristurus maderensis, Gaidropsarus argentatus, Neocyttus helgae, Tetrapturus pfluegeri* and *Reinhardtius hippoglossoides* from the Bay of Biscay, *Galeus murinus* from the Celtic Sea. It is also the first record of shark attack on human from the Bay of Biscay.

Quigley, D.T.G., Flannery, K., and O'Shea,J. 1989. Specimens of the Greenland halibut *Reinhardtius hippoglossoides* (Walbaum 1792) from Irish waters. Irish Naturalists' Journal 23: 111-112.

On 26 September 1986, a specimen of the Greenland halibut *Reinhardtius hippoglossoides* (Walbaum) was captured in the Puffin Channel, Dingle Bay (V4090), Co. Kerry. During August 1986, a second specimen of *R. hippoglossoides* was captured on the Porcupine Bank, off the west coast. The current specimens represent the second and third records of *R. hippoglossoides* from Irish waters; the Dingle Bay specimen being the first from within the 183m (100 fathom) line. The first Irish specimen was captured by trawl at a depth of 311m off the southwest coast (59 degree 30'N) in 1924.

Randa, K. and Smedstad, O.M. 1983. Preliminary report of the Norwegian groundfish survey at Bear Island and West-Spitsbergen in the autumn 1982 ICES CM 1983/G:34: 19 p.

This report describes the results from a stratified bottom trawl survey in the period 7 September to 9 October 1982.

Rasmussen, E.B., Salhauge, M.B., and Boje, J.1996. On the use of vertebral numbers to discriminate populations of Greenland halibut (*Reinhardtius hippoglossoides*, Walbaum) at West Greenland. NAFO SCR documents 96/14: 5 p.

Vertebral counts from samples of Greenland halibut (*Reinhardtius hippoglossoides*) in 1995 and 1989 were compared to previous samples in the period 1987-1989 for similar areas at West Greenland.The 1995 samples obtained in Davis Strait, Baffin Bay and two West Greenland fjords showed no significant differences in mean vertebral numbers. Previous studies in 1987-1989, however, showed significant differences in mean vertebral count between areas. Interannual variations in counts is thus higher than variation between areas sampled. Based on hydrographic conditions for recruitment, adults in the northernmost fjords of West Greenland are assumed to originate from other spawning grounds than the adults in Davis Strait. The present study therefore indicates that vertebral number is not a suitable character for revealing the population structures of Greenland halibut at West Greenland.

Rasmussen, E.B., Salhauge, M.B., and Boje, J.1999. The suitability of vertebral counts in stock delineation studies of Greenland halibut, *Reinhardtius hippoglossoides* (Walbaum), in West Greenland. ICES J. Mar. Sci. 75-83.

Vertebral counts of Greenland halibut collected from West Greenland in 1995 were compared to samples from the same areas for the period 1987-1989. The 1995 samples, obtained in Davis Strait, Baffin Bay, and two North-west Greenland Fjords, showed no significant differences in mean vertebral numbers. Previous studies in 1987-1989, however, showed significant differences in mean vertebral counts between some of the same areas. Inter-annual variation in vertebral numbers is therefore suggested to be greater than the variation between sample areas. Despite the protracted egg and larval stage of Greenland halibut, the currents along the West Coast of Greenland are unlikely to transport juveniles in any significant amount from the Davis Strait spawning grounds to the North-west Greenland Fjords. The origin of the northernmost populations therefore remains unknown. As single cohorts in the material seem to affect the total average counts per area significantly it is suggested that a change in the distribution of Greenland halibut might have occurred during the period studied. The results also emphasize the importance of relying on data based on more than one year and question the suitability of vertebral counts in stock delineation studies of Greenland halibut.

Rawson, B. 1991. Canadian request for sceintific advice on management in 1992 of certain stocks in Subareas 0 to 4. NAFO SCS documents 91/3: 1 p.

Rawson, B. 1992. Canadian request for scientific advice on management in 1993 of certain stocks in Subareas 0 to 4. NAFO SCS documents 92/2: 1 p.

Rawson, B. 1993. Canadian request for scientific advice on management in 1994 of certain stocks in Subareas 0 to 4. NAFO SCS documents 93/3: 2 p.

Rawson, B. 1994. Canadian request for scientific advice on management in 1995 of certain stocks in Subareas 0 to 4. NAFO SCS documents 94/4: 2 p.

Rätz, H.J. 1990. Reliability of abundance estimates derived from groundfish surveys conducted off east Greenland. ICES CM 1990/G:61: 26 p.

For the 1980-1989 decade, the abundance estimates in number and biomass are presented for the most common species off East Greenland (ICES Sub-division XIVb): *Anarchichas lupus, Gadus morhua, Hippoglossoides platessoides , Molva dipterygia, Reinhardtius hippoglossoides, Sebastes marinus, Sebastes mentella* . The estimates are derived from the annual groundfish survey established by the Federal Republic of Germany. The precision of the abundance estimates is investigated, comparing stratified (geographic and depth stratification) and unstratified sampling results. The 95% confidence intervals vary over a wide range and show a pronounced interannual variability. The stratification results in a more efficient estimator in abundance and biomass for all species apart from the redfish species S. mentalla . Frequently, the difference of the stratified and unstratified confidence intervals varies around 10% and amounts to 38% of the stratified mean for cod.

Rätz, H.J. and Lloret, J. 1999. Assessment of American plaice (*Hippoglossoides platessoides*) in NAFO Subarea 1 and ICES Div. XIVb based on survey indices, 1982-98. NAFO SCR documents 99/21: 11 p.

Stock abundance and biomass indices decreased from 100 million individuals and 20,000 tons during the erly 1980s to 50 million individuals and 5,000 tons in 1998. This decrease was caused by the stock reduction off West Greenland while the abundance off East Greenland remained fairly stable. The age structure of the stock component off West Greenland shrunk significantly by more than 2 years from an average age of 8 years in 1982 to a constant level below 6 years since 1990. The decrease of the spawning stock in number and weight off West Greenland is drastic and exceeded the level of 80%. The spawning stock-recruitment relation indicates a significantly reduced recruitment potential for SSF index <3,000 t, a possible candidate for a SSB9pa) value (mbal) for the West Greenland stock component. Since 1990, the SSB index remained below the 3,000 t level and consequently outside the safe biological level. F (0.1) and F (max) amounted to 0.14 and 0.23, F (msy) amounted to 0.1 and SSB (msy) to 3,000 t, respectively. The current mortality rates are indicated to significantly exceed sustainable levels. the low productivity of the stock can be explained by the slow growth and poor condition as a consequence of the sub-arctic environment. Furthermore, the American plaice off West Greenland displays a very late and slow maturation which indicates a high sensitivity to increased mortality rates.

Rätz, H.J. and Stein, M. 2000. German research report for 1999. NAFO SCS documents 00/11: 4 p.

Rätz, H.J., Stein, M., and Cornus, P. 1998. German research report for 1997. NAFO SCS documents 98/7: 3 p.

Rätz, H.J., Stein, M., and Cornus, P. 1999. German research report for 1998. NAFO SCS documents 99/9: 5 p.

Rätz, H.J., Stein, M., and Stransky, C. 2001. German research report for 2000. NAFO SCS documents 01/13: 6 p.

Rätz, H.J., Stein, M., and Stransky, C. 2002. German research report for 2001. NAFO SCS documents 02/9: 5 p.

Rätz, H.J., Stein, M., and Stransky, C. 2004. German research report for 2003. NAFO SCS documents 04/10: 7 p.

Rätz, H.J., Stransky, C., and Stein, M. 2005. German research report for 2004. NAFO SCS documents 05/9: 7 p.

Rehbein, H., Fricke, H.S.G., Oehlenschlaeger, J., and Antonacopoulos, N. 1984. Kennzeichnung von Seelachs-Scheiben in Oel [Characterization of sliced saithe in oil]. Fleischwirtsch. 64: 358-360.
[In German, English summary]

According to the Guiding Principles of the German Food Manual ("Leistaetze des Deutschen Lebensmittelbuches") only fish belonging to the Gadidae family can be used to manufacture sliced saithe in oil (salmon substitute). When commercial products were examined very high fat contents (17-20%) were in some cases found in the fish content of the product and these were accompanied by correspondingly low moisture contents. HPLC analysis showed that these samples had a lipid pattern characteristic of oily fish and clearly distinguishable from the majority of the other samples by its low content of polar lipids. Products made from oily fish were also found to have an unusual protein pattern at IEF of muscle extracts, the bands characteristic of saithe being absent - These findings indicated without doubt that oily fish had been used to make the products.

Reimer, L.W. and Ernst, P. 1989. Results of parasitological investigations as an index of stock delimitations concerning occurrences of Greenland halibut *(Reinhardtius hippoglossoides*

Walb.) in the Northwest Atlantic. NAFO SCR documents 89/73: 8 p.

Investigations concerning the infestation of Greenland halibut by blood protozoans as an index of stock classification in the North Atlantic.

Reinert, J. 1991. Faroe Islands research report for 1990. NAFO SCS documents 91/11: 6 p.

Reinert, J. 1992. Faeroe Islands research report for 1991. NAFO SCS documents 92/21: 5 p.

Reinsch, H.H. 1975. Aufnahme der Nutzfischbestaende im Barentsmeeer und bei Spitzbergen mit FFS 'Walther Herwig' vom 23.8.-19.9.1975 [Samples of commercial fish populations in the Barents Sea and near Spitzbergen taken by the FFS 'Walther Herwig' from Aug 8th to Sept 19th, 1975]. Inf. Fischwirtsch. 22: 158-162.
[In German]

Fishing records and data on the average length of some fish spp provide information on commercial fish stocks in the Barents Sea and in the waters round Bear Island and off Spitzbergen. Temperature measurements were taken at all fishery stations to study the effect of water temperature on fish presence.

Reinsch, H.H. 1978. Untersuchungen an den Nutzfischbestaenden auf dem Baereninsel-Schelf und vor Spitzbergen in Sommer 1978 [Studies on the commercial fish stocks on the Baeren Island shelf off Spitzbergen in summer 1978]. Inf. Fischwirtsch. 25: 133-137.
[In German]

Fishery-biology studies on the commercial fish stocks were conducted aboard the FES Anton Dohrn between 12.6 and 19.7.1978. In addition to a map of the route taken, tables are presented containing data on the catch protocol for cod, redfish, halibut, and blue whiting. Average lengths for individual study areas are also given. In another table results are presented on the occurrence of blue whiting. A graph of cod catches for 1976 and 1978 shows the reduction in cod catches in all 3 catch areas. Grenadier fish (*Macrourus berglax*) were only caught sporadically. Capelin and polar cod were almost completely absent from catches. Redfish showed heavy attack by *Sphyrion lumpi*.

Reinsch, H.H. 1980. Fischereibiologische Untersuchungen im Barentsmeer und westlich von Sptizbergen (101. Reisse des FFS Anton Dohrn vom 20.6. bis 27.7.1980) [Fishery-biological investigations in the Barents Sea and west of Spitzbergen (101 cruse of FRV Anton Dohrn from 20.6. to 27.7. 1980)]. Inf. Fischwirtsch. 27: 179-285.
[In German]

To get information of the horizontal distribution and the biology of commercially important fishes, a cruise was made in June/July 1980 to the Barents Sea and Spitzbergen. For *Gadus morhua, Reinhardtius hippoglossoides, Sebastes mentella* and *Micromesistius poutassou* the length distribution is given; for these and for some other species the catch rates in the different areas are summarized in a table.

Reinsch, H.H. 1981. Fischereibiologische Untersuchungen im Westlichen Barentsmeer und bei Spitzbergen (110. Forschungsreise des FFS "Anton Dohrn " vom 9.7.-11.8.1981) [Stock Assessment in the Western Barents Sea and Near Spitzbergen (110 cruise of FRV Anton Dohrn from 9.7.-11.8.81)]. Inf. Fischwirtsch. 28: 164-171.
[In German]

Annual investigations on the stocks of North Atlantic fish are carried out since 1974. On the 110th cruise of the FFS Anton Dohrn (9.7.-11.8.81) first of all the stocks of the cod (*Gadus morhua*), redfish (*Sebastes marinus*) and Greenland halibut (*Reinhardtius hippoglossoides*) were studied. First of all the size distribution, sex ratio and the stomach contents. The positions of trawling were determined by the stratified random sampling system, as it is done since 1979.

Reinsch, H. H., Schillat, B., Meyer, A., Klug, G., Seydlitz, H., and Stein, M. 1975. Bericht ueber die 56.(11.) Forschungsreise des Fischereiforschungsschiffes 'Walther Herwig' ins Barentsmeer und nach Spitzbergen vom 19.6.-19.8.1974 [Report on the 56th (11th) study trip of the fishery research vessel 'Walther Herwig' to the Barent Sea at Spitzbergen from the 19th June to the 19th August, 1974]. Bundesforschungsanstalt fur Fischerei, Hamburg (Germany). Schriften der Bundesforschungsanstalt fur Fischerei; 17. 57 p.
[In German]

Commercial fish stocks in the Barents Sea and near Spitzbergen were studied with particular consideration of cod, shellfish and red perch. Age compositions and summer migration for food were established. Temperature and salinity were measured on surface and sea bottom at the fishery stations. Additional hydrographic sections were used to observe summer temperature increases, the site of the oceanic polar front and for the assessment of the presence of fish and their temperature and salinity limits.

Richards, D., Treble, M., Siferd, T., and Cosens, S. 2004. Canadian research report for 2003. Part I, Newfoundland and Labrador Region, Part II, Central and Arctic Region. NAFO SCS documents 04/8: 29 p.

Rideout, R.M., Maddock, D.M., and Burton, M.P. 1999. Oogenesis and the spawning pattern in Greenland halibut from the North-west Atlantic. J. Fish Biol. 54: 196-207.

Gametogenesis in Greenland halibut *Reinhardtius hippoglossoides* from the North-west Atlantic is not synchronous between individuals of the same population suggesting that the spawning season is not well defined. Differences in oocyte size-frequency distributions in prespawning, spawning and spent conditions suggest that Greenland halibut are capable of de novo vitellogenesis prior to and during spawning, indicating that the spawning pattern is not determinate. Greenland halibut may be capable of fast-tracking oocytes to maturity, whereby during the spawning season oocyte batches may be brought quickly through vitellogenesis so as to increase the fish's yearly reproductive output.

Riget, F. and Boje, J.1987. Biology and fishery of Greenland halibut at West Greenland. NAFO SCR documents 87/81: 29 p.

Riget, F. and Boje, J.1987. Distribution and abundance of young Greenland halibut (*Reinhardtius hippoglossoides* Walb.) in west Greenland waters. NAFO SCR documents 87/35: 12 p.

Riget, F. and Boje, J.1987. Migration and exploitation of Greenland halibut, *Reinhardtius hippoglossoides* (Walb.), in the Nuuk area, West Greenland based on tagging experiments in 1969-70. NAFO SCR documents 87/34: 6 p.

Riget, F. and Boje, J.1988. Distribution and abundance of young Greenland halibut (*Reinhardtius hippoglossoides* Walb.) in west Greenland waters. Northwest Atl. Fish. Organ. Sci. Counc. Stud. 12: 12 p.

Distribution and abundance of young Greenland halibut (*Reinhardtius hippoglossoides*) at West Greenland are described on the basis of stratified-random bottom-trawl surveys in 1982-84 and research trawling for shrimp during 1968-87. Greenland halibut abundance was low in the offshore areas (south of 67 degree N) covered by the bottom-trawl surveys and shrimp-trawl operations, but the catch rates tended to increase from south to north. The greatest abundance was found in the offshore north of Store Hellefiske Bank and in Disko Bay (north of 68 degree N).

Riget, F. and Boje, J.1988. Length-weight relationship and condition factor of Greenland halibut in West Greenland waters. NAFO SCR documents 88/14: 12 p.

Riget, F. and Boje, J.1989. An analysis of meristic characters of Greenland halibut (*Reinhardtius hippoglossoides* W.) in the Northwest Atlantic. NAFO SCR documents 89/25: 11 p.

> As part of a stock identification study of Greenland halibut meristic characters from six areas in the western North Atlantic were analyzed. No correlation between count of meristic characters and length of fish was found. No differences in meristic characters between sexes were found. Left and right pectoral fin ray numbers as well as anal and dorsal fin ray numbers were highly correlated but were not correlated with vertebral numbers. No significant differences in numbers of pectoral, anal and dorsal fin rays were found between any of the areas, whereas numbers of vertebrae showed significant heterogeneity.

Riget, F. and Boje, J. 1989. Fishery and some biological aspects of Greenland halibut (*Reinhardtius hippoglossoides)* in West Greenalnd waters. Northwest Atl. Fish. Organ. Sci. Counc. Stud. 13: 41-52.

> A review of available information is presented of recent investigations on the fishery and biology of Greenland halibut (*Reinhardtius hippoglossoides)* in West Greenland waters. Biological aspects are discussed mainly in relation to the recruitment to West Greenland area and the connection between the stocks in the West Greenland fjords and the stock complex in the Davis Strait. Larval drift is discussed relating the distribution of pelagic larvae and young demersal stages to the ocean current patterns in the area. Although the main drift pattern seems to be from the assumed spawning area in the Davis Strait to the West Greenland area, it also seems likely that larvae drift from the East Greenland/Iceland area to the southern part of West Greenland. Length frequencies at different places in the West Greenland area seem to indicate that as they grow they migrate deeper, both to the fjords and the continental slope in the Davis Strait. Recaptures from tagging experiments in the inshore area have all been near the tagging site, except for two examples of long distance migrations. A spawning migration from the fjords to the Davis Strait area have not been confirmed by tagging experiments. The recapture rates are shown to be independent of the length of fish. The sex ratios in the fjords at the West Greenland show the proportion of females as generally being the higher and that it is very similar to observed sex ratio on the continental slope of the Davis Strait. Observations on maturity show that a small proportion of the females and a larger proportion of the males in the West Greenland fjords are found in maturity stages just before or at spawning, suggesting that spawning, to some extent, takes place in the fjords. It is therefore proposed that Greenland halibut in the West Greenland fjords are mainly stationary and do not participate in the spawning in the deeper areas of the Davis Strait south of 67.degree.N.

Riget, F. and Pedersen, S.A. 1991. Feeding habits of Greenland halibut in west Greenland waters with special emphasis on predation on shrimp and juvenile redfish. NAFO SCR documents 91/49: 10 p.

> The most important shrimp grounds of West Greenland are in Subarea 1B and 1C where the catches in the latest years have been about 40,000 tons. These areas are also important nursery grounds for Greenland halibut and redfish and it is well known that great numbers of these fish are caught as by-catch in the shrimp fishery (Sidt, 1969; Riget et al. 1988; Pedersen and Lehmann, 1989).

Riget, F., Boje, J., and Lehmann, K. 1988. By-catches of Greenland halibut and redfish in the shrimp fishery at West Greenland. NAFO SCR documents 88/12: 15 p.

Riget, F., Boje, J., and Simonsen, V. 1992. Analysis of meristic characters and genetic differentiation in Greenland halibut (*Reinhardtius hippoglossoides*) in the Northwest Atlantic. J. Northwest Atl. Fish.Sci. 12: 7-14.

A stock identification study of Greenland halibut (*Reinhardtius hippoglossoides*) in the Northwest Atlantic was carried out based on samples from off eastern Newfoundland, Davis Strait, three West Greenland fjords and Denmark Strait. Meristic characters and frequencies of electrophoretically detectable alleles of protein loci were analyzed. Although the Denmark Strait stock could not be separated from the stock in the area between West Greenland and Canada, results support the conclusion that at least two spawning stocks exist in the Northwest Atlantic. Results are consistent with the prevailing theory that Greenland halibut form a single, interbreeding stock in the offshore area between Canada and West Greenland, but also agree with other evidence that Greenland halibut in West Greenland fjords are partially isolated from the offshore stock.

Rikhter, V.A. 2001. On the relation between recruitment dynamics of some fish populations in the Northwestern Atlantic Ocean (NAFO Subareas 2-4). NAFO SCR documents 01/6: 14 p.

The relation between recruitment dynamics of 12 fish populations in North-Western Atlantic (NAFO Subareas 2-4) is analyzed. In 19 cases of 66 significant correlations reliable at 95 and 99% probability have been revealed. The direct relation between cod 2J + 3 KL and 3 NO and other gadoid populations of Nova Scotian area (pollock 4VWX + 5Zc, cod 4VsW, haddock 4TVW) as well as the negative correlation between Greenland halibut 2+2KLMNO and cod 3NO, 4VsW and pollock seems to be of the most interest. On the basis of obtained results the possibility has been considered to reveal the current trends of recruitment dynamics in several stocks simultaneously in the cases when no reliable data is available on the year-classes appeared during the latest years of observations. The opinion has been expressed that availability of stable relations mentioned above provides the basis of predicting the trends of respective populations biomass for several years in advance.

Rikhter, V.A. 2002. On the reasons of correlation between recruitment dynamics of some commercial fish populations in the northwestern Atlantic Ocean (NAFO Subareas 2-4) and probability of forecasting the trends in dynamics of their biomass for several years ahead. NAFO SCR documents 02/1: 12 p.

The comparative analysis of recruitment dynamics of nine commercial fish populations (stock units) and water temperature in the Northwestern Atlantic (NAFO Subareas 2-4) has been carried out. It was found that the occurrence of weak generations in seven populations (2J+3KL, 3NO, 4VxW cod (*Gadus morhua*), 3LNO American plaice (*Hippoglossoides platessoides*), 4TVW haddock (*Melanogrammus aeglefinus*), 4VWX+5Zc pollock (*Pollachius virens*), 4VWX silver hake (*Merluccius bilineari*)) coincided with the periods of strong and rather long fall of temperatures, while in two populations (2J+3KLMNO Greenland halibut (*Reinhardtius hippoglossoides*), 3LNO yellowtail flounder (*Pleuronectes ferruginea)*) the inverse process was observed. The assumption was made, that the reason of reliable correlation between recruitment dynamics of stock units under consideration was the identical (or opposite) reaction to interannual fluctuations of water temperature. The attempt was made to obtain the general idea on the trends of fishing and spawning biomass dynamics of respective populations during the first decade of the new century.

Rikhter, V.A. 2003. On the TAC estimates compliance with some commercial fish stocks in NAFO area: restrospective analysis and improvement possibilities. NAFO SCR documents 03/2: 13 p.

The attempt has been made to reveal the compliance of TAC values adopted in ICNAF-

NAFO area in 1973-2000 for the following stock units: Div. 2+3KLMNO Greenland halibut, Div. 3LNO American plaice, Div. 3LNO yellowtail flounder, 3M beaked redfish, Div. 2J+3KL, Div. 3M, Div. 3NO cod and Div. 4VWX silver hake. The introduction of stock state categories became the methodical basis of the analysis. The latter were further compared to actual TAC values. The plots of the relationship between the values considered and correlation coefficients allowed to conclude that in most cases TACs adopted were not adequate to the actual stock state. The limits of "improved" TACs were estimated for each category. The results obtained became the basis of so-called conservative approach (CA) to assessment of a stock state and allowable catches for a year ahead. The examples of CA application in practice are presented. The application terms of the proposed approach, which can be assigned to the group of non-parametric semi-quantitative methods, are formulated.

Rikhter, V.A. 2004. Once more on the stock-recruitment relationship as one of the factors determining the abundance dynamics and fisheries management strategy for some commercial fish species in NAFO Area. NAFO SCR documents 04/2: 13 p.

The stock-recruitment relationship (SRR) was researched in 13 stock units of commercial fishes in NAFO area, and for this purpose the retrospective estimates of recruitment abundance and spawning biomass were used. The results obtained were analyzed in view of the interpretation of the above said relationship as one of the factors determining the abundance dynamics and fisheries management strategy for commercial fish populations. The effect of SRR was most evident in 8 populations (3Ps cod *Gadus morhua*, 5Ze, 5Zw+6 silver hake *Merluccius bilinearis*, 5Ze red hake *Urophycis chuss*, 2+3 Greenland halibut *Reinhardtius hippoglossoides* 3LNO yellowtail flounder *Limanda ferruginea*, 3LNO American plaice *Hippoglossoides platessoides*, and 3-6 Atlantic mackerel *Scomber scombrus*). Certainly, the environment factors affected recruitment abundance formation to a different extent in all cases. The results of the study allowed proposing some general recommendations on the ways of the researched stock unit's management. The probable mechanism of SRR effect in the periods when the spawning biomass considerably differed from the optimal level was considered and within the discussion the opinion was expressed concerning further development of the precautionary approach strategy.

Rikhter, V.A. and Sigaev, I.K. 1994. Russian national research report for 1993. NAFO SCS documents 94/3: 14 p.

Rikhter, V.A. and Sigaev, I.K. 1995. Russian research report for 1994. NAFO SCS documents 95/4: 14 p.

Rikhter, V.A. and Sigaev, I.K. 2002. Russian research report for 2001. NAFO SCS documents 02/4: 25 p.

Rikhter, V.A. and Sigaev, I.K. 2003. Russian research report for 2002. NAFO SCS documents 03/6: 31 p.

Rikhter, V.A., Sigaev, I.K., Borovkov, V., Kovalev, S., and Savvatimsky, P. 1991. USSR research report for 1990. NAFO SCS documents 91/5: 25 p.

Rikhter, V.A., Sigaev, I.K., Vaskov, A.A., Savvatimsky, P.I., and Vinnichenko, V.I. 1996. Russian research report, 1995. NAFO SCS documents 96/3.

Rikhter, V.A., Sigaev, I.K., and Vaskov, A.A. 1997. Russian research report, 1996. NAFO SCS documents 97/3: 6 p.

Rikhter, V.A., Sigaev, I.K., Vaskov, A.A., Gorchinsky, T.M., Igashov, V.M., Kiseleva, V.M., and Melnikov, S.P. 2001. Russian research report for 2000. NAFO SCS documents 01/11: 17 p.

Rivard, D. and Casey, J. 1998. Evaluation of possible limit reference points for Greenland halibut in NAFO Subareas 2+3, including an approach based on escapement considerations. NAFO SCR documents 98/77: 13 p.

When analytical assessments are available, reference points can be defined in terms of biomass or fishing mortality. For Greenland halibut (*Reinhardtius hippoglossoides*) in NAFO Subareas 2+3, there exists little information on the absolute estimate of biomass. Historic data from research surveys and on the historic catch level do exist, together with estimates of total mortality calculated from the surveys. The authors discuss various ways to utilize these data in the determination of limit reference points for this resource, using equilibrium yield and biomass per-recruit calculations.

Rockower, R. K., Deng, J. C., Otwell, W. S., and Cornell, J. A. 1982. Evaluation of the textural attributes of minced fish patties made from fish (turbot and pollock), soy flour, soy protein concentrate and sodium alginate. *In* Proceedings of the seventh annual Tropical and Subtropical Fisheries Technological Conference of the Americas : January 11-14, 1982, New Orleans, Louisiana. Edited by Nickelson, R. Texas A&M University. Sea Grant Program; TAMU-SG-82-110: pp. 36-47.

Work focused on developing a fish patty made from fish bits and pieces remaining after cutting frozen blocks of pollock (*Pollachius virens*) and Greenland turbot (*Reinhardtius hippoglossoides*). These two fish species, a lean and fatty species respectively, were blended in varying formulations with soy protein concentrate, soy flour and sodium alginate. Objective and subjective characteristics, composition, and cost parameters were studied as a function of ingredient levels. The purpose of this work was to develop a marketable product based on sensory, economic and compositional characteristics. This study varies from previous work becasuse of the two specific fish species used, selection of soy flour rather than potato, wheat or rice flour, and the specific levels and combinations of ingredients studied.

Rockower, R.K., Deng, J.C., Otwell, W.S., and Cornell, J.A. 1983. Effect of soy flour, soy protein concentrate and sodium alginate on the textural attributes of minced fish patties. J. Food Sci. 48: 1048-1052.

A mixture response statistical design was used to investigate the textural attributes of minced fish patties. Patties formulated with pollock (*Pollachius virens*) were significantly firmer than those made from turbot (*Reinhardtius hippoglossoides*) and pollock blends or from turbot alone. Breakpoint values and firmness scores were negatively correlated with flavor and acceptability scores indicating that as patty firmness increased general acceptability declined. Higher acceptability for softer patties formulated with more turbot were attributable to the higher fat content. Increasing the soy protein levels and decreasing alginate content increased patty firmness regardless of fish composition. The patty formulation with maximum predicted acceptability was 78% turbot, 11% soy flour, and 11% soy protein concentrate.

Rodriguez-Marin, E. and del Rio, J.L. 1999. Length distributions and recruitment index of northern shrimp (*Pandalus borealis*) in Flemish Cap (Division 3M) in 1993-1998, as inferred from stomach contents analysis of cod (*Gadus morhua)*, Greenland halibut (*Reinhardtius hippoglossoides*) and thorny skate (*Raja radiata*). NAFO SCR documents 99/73: 14 p.

From stomachs of cod (*Gadus morhua*), Greenland halibut (*Reinhardtius hippoglossoides*) and thorny skate (*Raja radiata*) sampled in the fishing surveys carried out in Flemish Cap in July from 1993 to 1998, the importance in diet, predator-prey relationship and length frequency of northern shrimp (*Pandalus borealis*) were evaluated. These three species prey on different lengths of northern shrimp as a function of their feeding habits and the overlap in their ranges of vertical distribution with that of their prey. The ability of these predators to sample different sizes of northern shrimp allows the observation of the annual progression of strong year classes of this prey and the estimate of its recruitment at age 2 from its frequency of occurrence in cod stomach contents from 1989 to 1997.

Rodriguez-Marin, E., Punzon, A., and Paz, J. 1993. Greenland halibut (*Reinhardtius hippoglossoides*) feeding in Flemish Pass - NAFO Divisions 3LM. NAFO SCR documents 93/18: 9 p.

A qualitative study of Greenland halibut (*Reinhardtius hippoglossoides*) food composition in NAFO Divisions 3LM was made by analysis on board ship from 4987 stomachs, in 1992. Fish were caught at unusual depths, ranging from 720 to 1533 m, with an average of 979 m. The frequency of occurrence of food items was used to evaluate the importance of prey groups. Examination revealed a wide prey spectrum. Cephalopods (32%), Decapod crustaceans (22%) and fish (39%) were the main items, with cannibalism reaching 2%. The mean percentage of empty stomachs was 69%. Variations in diet according to predator size, batimetric distribution, and month between spring and autumn were also found. Furthermore the influence of the fishery on diet, through waste products discarded after processing has been observed.

Rodriguez-Marin, E., Punzon, A., Paz, J., and Olaso, I. 1994. Feeding of most abundant fish species in Flemish Cap in summer 1993. NAFO SCR documents 94/35: 33 p.

The stomach contents of 4320 fishes comprising 14 species were collected from Flemish Cap Bank (NW Newfoundland) at depths ranging from 130 to 730 m, during summer 1993. The general feeding intensity was high in all species. Three main feeding patterns were evident : the genus Sebastes consume primarily pelagic species, although they also feed on preys which migrate vertically such as shrimps, Euphausids and mysids. the benthic group is made up of American plaice (*Hippoglossoides platessoides*), witch flounder (*Glyptocephalus cynoglossus*), arctic eelpout (*Lycodes reticulatus*), wolffishes (*Anarhichas lupus* and *Anarhichas minor)* and thorny skate (*Raja radiata*). lastly, the group of benthopelagic fish remains, longfin hake *(Urophycis chesteri)*, cod (*Gadus morhua*), grenadiers *(Nezumia bairdi* and *Macrourus berglax*) and Greenland halibut *(Reinhardtius hippoglossoides*). Pelagic and benthopelagic preys are an important food resource for all fish considered, the abundance of Hyperids, *P. borealis* and *Sebastes* sp. in summer makes them an important food resource in the diet of fish in Flemish Cap.

Rodriguez-Marin, E., Punzon, A., and Paz, J. 1995. Feeding patterns of Greenland halibut (*Reinhardtius hippoglossoides*) in Flemish Pass (northwest Atlantic). Northwest Atl. Fish. Organ. Sci. Counc. Stud. 23: 43-54.

A qualitative study of the food composition of Greenland halibut (*Reinhardtius hippoglossoides*) was made by on-board analysis of commercially caught fish in 1992. The fish were caught east of Newfoundland (NAFO Div. 3LM) in unusually deep waters, with an average of 1 040 m. Variations in feeding according to predator size, depth and month were studied. The annual average percentage of empty stomachs was 69%, increasing through the year for specimens over 60 cm. The frequency of occurrence (FO) of food items was used to evaluate the importance of prey groups. Fish (39%), cephalopods (32%) and decapod crustaceans (22%) were the main items, with cannibalism reaching 2%. An abrupt change in diet composition occurred in fish between 60 and 69 cm, from feeding on decapod crustaceans and cephalopods to fish and factory ship discarded offal. The influence of the fishery itself on the diet of Greenland halibut was observed when an important food component in the largest specimens (>60 cm) consisted of offal discarded after fish processing. This study indicates that the FO of the main prey groups bears more relation to the size of fish than with depth.

Rodriguez-Marin, E., de Cárdenas, E., and Paz, J. 1997. Feeding of Greenland halibut (*Reinhardtius hippoglossoides)* in 3LMNO NAFO regulatory area divisions (Northwest Atlantic), 1991-1994. NAFO SCR documents 97/37: 10 p.

Feeding of Greenland halibut in Flemish Pass and Newfoundland's Grand Bank slope was studied from on board commercial fleet analysis, from June 1991 to December 1994. Percentage of empty stomachs from 625 165 specimens and frequency of occurrence of prey from 18, 527 stomachs, were used to evaluate feeding intensity and importance of prey groups. Examination revealed increasing feeding intensity with size. The emptiness percentage varies with depth, in a directly proportional way, in specimens of less than 60 cm, and is inversely proportional in those of over 70 cm. A smaller percentage of empty stomachs was found in females than in males, upwards of the length of first maturity of the latter, as well as a decreasing feeding rate as females become reproductively active. Analysis of frequency of occurrence of main prey groups indicated a change in Greenland halibut feeding at 60 cm in all divisions, a change which supposes a fall in consumption of crustaceans and molluscs, an increase in fish and offal, and an increase in prey species size. The difference between divisions is due to the consumption of *Mallotus villosus* by specimens of less than 60 cm in divisions 3NO. There also significant changes with depth at around 1000 m in the diet of *Reinhardtius hippoglossoides* of less than 60 cm, bringing about a substitution of capelin for decapod cephalopods. At graet depths squid have a similar role in the diet of Greenland halibut to that played by capelin on the continental shelf. The variation of the prey species is related to their distribution. Offal are an extra provision of food introduced by fishing activity, making up the second most important prey group in specimens of over 60 cm.

Rokicki, J. 1982. Ektopasozyty halibuta niebieskiego *Reinhardtius hippoglossoides* (Walbaum, 1972) z lowisk Labradoru [Ectoparasites of the Greenland halibut *Reinhardtius hippoglossoides (*Walbaum, 1972) from the Labrador fishing grounds]. Wiad. Parazytol. 28: 199-204.
[In Polish, English summary]

Román, E. and Paz, X. 1997. Length/weight relationships for Greenland halibut, *Reinhardtius hippoglossoides*, from Northwest Atlantic (NAFO Regulatory Area: Divisions 3L, 3M and 3NO). NAFO SCR documents 97/16: 18 p.

Sampling length and weight data collected during Flemish Cap surveys (1995 and 1996) and fishing activity monitoring (1993 and 1994) were used to produce relationships and plots for length-weight and gutted length-weight for Greenland halibut, *Reinhardtius hippoglossoides* in the NAFO Regulatory Area (Divisions 3L, 3M and 3NO). The parameter values were obtained by sex, division and by semester.

Román, E., Paz, X., and Munoz, P.D. 2001. Comparative fishing between the R/V Wilfred Templeman and the C/V Playa De Menduna in the NAFO Divisions 3NO in May 2001. NAFO SCR documents 01/69: 13 p.

Following the recommendations of the 2000 Scientific Council Meeting, comparative fishing was conducted for the second time between Canadian and Spanish survey vessels in the Grand Bank (NAFO Div. 2NO) during 21 to 23 of May 2001. Although this year three ships were involved in the comparative experience, this paper presents only the results of the comparison between C/V Playa de Menduina and R/V Wilfred Templeman. This paper presents the results of this 2001 comparative fishing from the Spanish vessel and the catches by set for the Canadian vessel. In addition, the catches in weight and in number for the main species (*Hippoglossoides platessoides, Pleuronectes ferrugineus, Raja radiata, Gadus morhua, Reinhardtius hippoglossoides)* corresponding to both Spanish and Canadian vessels in the 2000-01 comparative fishing exercises are presented.

Román, E., Gonzalez, C., and Paz, X. 2004. Condition and feeding of Greenland halibut (Reinhardtius hippoglossoides) in Flemish Cap and other areas, 1992-2003. NAFO SCR documents 04/60: 20 p.

The seasonal, annual and geographical changes in the relative condition factor of a total of 65,113 individual biological data of Greenland halibut (*Reinhardtius hippoglossoides*) were analysed. These data were collected in three areas of the North Atlantic (NAFO Div. 3LNO and 3M, and ICES Div. 2b) in commercial fishing and scientific surveys from 1992 to 2003. The condition stage varied significantly among areas considering the season and sex, with a slightly increasing general trend in 3M and 2b, and descending in 3LNO in the studied period, but any clear pattern over time in any area. This index showed high differences among the three areas in the individuals ~.80 cm. This group showed a similar condition in Div. 3LNO and 3M but smaller in 2b, however the values were similar in inferior sizes for the three areas. There was a decrease of the condition in the intermediate sizes (30-60 cm) in the three areas in all the seasons. In general, the condition of males was slightly higher than in females, but both sexes presented annual oscillations. Relationship between the condition stage and the estimated biomass was not appreciated. A total of 8931 Greenland halibut stomachs were collected in summer 1993-2003 in Flemish Cap. Feeding intensity was higher on Flemish Cap than in other areas. The most important preys were *Pandalus borealis, Sebastes* spp. and Hyperiidea. Feeding habits by size range and the comparison among different Divisions were also analysed.

Rowat, W.A. 1995. Canadian request for scientific advise (sic) on management in 1996 of certain stocks in Subareas 0 to 4. NAFO SCS documents 95/3: 2 p.

Rowat, W.A. 1996. Canadian request for scientific advice on management in 1997 of certain stocks in Subareas 0 to 4. NAFO SCS documents 96/2: 2 p.

Rowat, W.A. 1997. Canadian request for scientific advice on management in 1998 of certain stocks in Subareas 0 to 4. NAFO SCS documents 97/1: 2 p.

Roy, J.M. 1973. Les flétans. Poissons du Québec; 9. 20 p.
[In French]

Rønneberg, J.E., Gundersen, A.C., and Boje, J.1998. Fecundity of Greenland halibut (*Reinhardtius hippoglossides* Walbaum) in East Greenlandic waters. ICES CM 1998/O:26: 1998.

Studies on fish fecundity is of importance for understanding reproduction biology and relations between spawning stock and recruitment. Fecundity is defined as the number of vitellogenic oocytes developing in a female prior to the spawning. For Greenland halibut (*Reinhardtius hippoglossoides*) in East-Greenland waters fecundity has not been described so far. This paper describes a fecundity study on Greenland halibut in ICES area XIVb, East-Greenland, based on 112 ovaries collected in July 1997. The ovaries contained oocytes with a visual oocyte diameter of 1-2 mm. Mean gonadosomatic index (GSI) was 2.9 %, ranging from 1.0 % to 4.9 %. Among the eggs in the ovary, a recruitment group in the connective tissue, small oocytes (mean egg diameter 0.73 mm after preservation) and vitellogenic oocytes (mean egg diameter 1.25 mm after preservation, range 0.9 - 1.65 mm) were observed. The fecundity estimates are based on the vitellogenic oocytes in the last group. Mean fecundity was estimated to 113 700 eggs, the number of eggs per female, ranging from 32 500 to 277 100. The fecundity-length and fecundity-weight (F-W) relationships have been estimated.

Rubec, L.A. 1988. *Neobrachiella rostrata* (Copepoda: Lernaeopodidae) on the gills of the Greenland halibut, *Reinhardtius hippoglossoides* from the Gulf of St. Lawrence. Can. J. Zool. 66: 504-507.

A short form of Neobrachiella rostrata is found on the gills of Greenland halibut, *Reinhardtius hippoglossoides*, in the Gulf of St. Lawrence. Female copepods from Greenland halibut differ from females occurring on Atlantic halibut, Hippoglossus hippoglossus , in body size and shape of trunk; males differ in the specific structural details of the second antenna and maxilliped and in the presence of armed uropods and a tympanum between the second maxillae. Intraspecific variations are commonly found in females of the genus Neobrachiella but have never been reported in males.

Saborido-Rey, F. and Vazquez, A. 2001. Results from bottom trawl survey on Flemish Cap of July 2000. NAFO SCR documents 01/22: 56 p.

A stratified random bottom trawl survey on Flemish Cap was carried out on July 2000 up to a depth of 730 metres. Survey results are presented and compared with results of previous surveys in the series since 1988. Abundance at age indices are presented for cod (*Gadus morhua)*, American plaice (*Hippoglossoides platessoides*), redfish (*Sebastes mentella*) and Greenland halibut (*Reinhardtius hippoglossoides*). Results from a comparative trial between the survey gear (Lafoten) and a Campelen 1800 shrimp trawl are presented.

Saborido-Rey, F. and Vazquez, A. 2003. Results from bottom trawl survey on Flemish Cap of July 2002. NAFO SCR documents 03/42: 41 p.

A stratified random bottom trawl survey on Flemish Cap was carried out on July 2002 up to a depth of 730 m. Survey results are presented and compared with those of previous surveys in the series since 1988. Abundance at age indices was presented for cod (*Gadus morhua*), American plaice *(Hippoglossoides platessoides*), redfish (*Sebastes mentella*) and Greenland halibut (*Reinhardtius hippoglossoides*).

Sanjuan, A. and Comesana, A.S. 2002. Molecular identification of nine commercial flatfish species by polymerase chain reaction-restriction fragment length polymorphism analysis of a segment of the cytochrome b region. J. Food Prot. 65: 1016-1023.

Commercial refrigerated or frozen flatfish fillets are sometimes mislabeled, and identification of these mislabeled products is necessary to prevent fraudulent substitution. Identification of nine commercial flatfish species (order Pleuronectiformes), *Hippoglossus hippoglossus* (halibut), *Lepidorhombus boscii* (four-spotted scaldfish), L*epidorhombus whiffiagonis* (megrin), *Platichthys flesus* (flounder), *Pleuronectes platessa* (European plaice), *Reinhardtius hippoglossoides* (Greenland halibut), *Scophthalmus maximus* (turbot), *Scophthalmus rhombus* (brill), and *Solea vulgaris* (=*Solea solea*) (sole), was carried out on the basis of the amplification of a 486-bp segment of the mitochondrial genome (tRNAGlu/cytochrome b) by using the polymerase chain reaction (PCR) and universal primers. Sequences of PCR-amplified DNA from the flatfish species were used to select eight restriction enzymes (REs). The PCR products were cut with each RE, resulting in species-specific restriction fragment length polymorphism. Seven species groups could be identified by application of the single RE DdeI and six species groups by using HaeIII, HinfI, MaeI, or MboI. Different combinations of only a couple of these REs could unambiguously identify the nine flatfish species. Genetic polymorphisms of the target sequence were examined by comparison with previously published DNA sequences, and the results of this comparison confirmed the usefulness of this technique in distinguishing and genetically characterizing refrigerated or frozen pieces of these nine flatfish species.

Satani, M., Kawahara, S., and Jørgensen, O. 1993. Results of two stratified random bottom trawl surveys at West Greenland in 1992. NAFO SCR documents 93/58: 12 p.

Since 1987 Japan Marine Fishery Resource Research Center (JAMARC) and Greenland Fisheries Research Institute (GFRI) have conducted cooperative trawl surveys off West and East Greenland (Yamada et al., 1988a: Yamada et al., 1988b: Yatsu and Jorgensen, 1989: Jorgensen and Akimoto, 1990: Jorgensen and Akimoto 1991: Yano and Jorgensen, 1992). In 1992 two stratified random bottom trawl surveys were carried out only off West Greenland. The aim of the surveys was to estimate stock sizes of groundfish and to obtain information on distribution, size composition and biology of Greenland halibut (*Reinhardtius hippoglossoides)*, beaked redfish (*S. mentella*) and roundnose grenadier (*Coryphaenoides rupestris*) on the continental slope between Div. 1A (south of 70 Degrees N) and 1D.

Savvatimsky, P.I. 1986. Changes in composition of the bottom fish catches at different depths along the continental slope in NAFO Subareas 0, 2 and 3 in 1970-85. NAFO SCR documents 86/67: 26 p.

Savvatimsky, P.I. 1987. Changes in species composition of trawl catches by depth on the continental slope from Baffin Island to northeastern Newfoundland, 1970-85. Northwest Atl. Fish. Organ. Sci. Counc. Stud. 11: 43-52.

Considerable cooling of the water masses in the northern subareas of the Northwest Atlantic occurred during 1973-85, and this influenced the redistribution of beaked redfish, (*Sebastes mentella*) Greenland halibut (*Reinhardtius hippoglossoides)* and roundnose grenadier (*Coryphaenoides rupestris*), which moved to greater depths. The change in hydrological conditions was evidently one of the reasons for the great reduction in nominal catches of roundnose grenadier after 1978. The analysis of bottom-trawl catches by USSR research vessels along the continental slope from Baffin Island to northeastern Newfoundland during autumn investigations in 1970-85 showed that the mean length of roundnose grenadier decreased during the most recent 5-6 years, with the largest decrease in the northernmost area (Baffin Island) where hydrological conditions could affect the fish populations to a greater extent than in the more southerly areas.

Savvatimsky, P.I. and Gorchinsky, K.V. 1998. Results from studies on length and weight growth rate in *Macrourus berglax* and its bathymetric distribution off the Bear Island (the Norwegian Sea) and in the Northwest Atlantic. NAFO SCR documents 98/19: 9 p.

Comparative data are presented on age, length and weight growth rate, as well as on length-age composition of roughhead grenadier (*Macrourus berglax*), caught off Bear Island, in the Norwegian Sea, and in the Northwest Atlantic, during the fishery on Greenland halibut (*Reinhardtius hippoglossoides).* Bottom trawl hauls were performed at 500-800 m. Grenadier bycatch did not exceed 5%. Mean length of males (52.7-54.1 cm) and females (57.0-60.9 cm) increased with fishing depth. Grenadier were aged by scale under polarized transmitted light. Males 30-72 cm long (mean length - 52.4 cm) at age 6-18 and females 30-89 cm long (mean length - 58.0 cm) at age 6-22 occurred in catches. Length composition of males and females is similar to that of fish in the Flemish Pass area and in the NAFO Divs. 3K, 3L and 3N. Length and weight growth rate in males and females of grenadier in the Bear Island area is lower compared to that of grenadier in the Northwest Atlantic.

Savvatimskij, P.I. and Gorchinsky, K.V. 2001. By-catch of grenadiers in directed fishery for Greenland halibut in Divisions 3LMN and size, age and sex composition of roughhead grenadier in 2000. NAFO SCR documents 01/9: 12 p.

In 2000 Greenland halibut (*Reinhardtius hipploglossoides*) fishery by Russian vessels took place in Div. 3L - in January-May, 3M - in April-May and July, 3N - in March. Three species of grenadier (Macrouridae) occurred as a steady by-catch: roughhead grenadier (*Macrourus berglax*), roundnose grenadier (*Coryphaenoides rupestris*) and common rat-tail. By-catch of roundnose grenadier and common rat-tail was insignificant and these species are of no commercial value. By-catch was composed primarily of roughhead grenadier, although on the average it was small. Greatest by-catches were taken from depths of about 1000m and accounted for 6%. However, individual by-catches of this species were as large as 2 and even 3 t per haul. The catch of roughhead grenadier was dominated by individuals of 18-98 cm. Size composition of grenadier was similar in all divisions; it did not differ between months either. In general, catches from Div. 3LMN contained fish at age from 1 to 21 years with males and females at age 6 prevailing. Size and age of fish increased with depth of fishing from 800 to 1,300 m, relative number of females declined. A general regularity is that females of grenadier have a longer life cycle therefore the catches virtually never contained males larger than 54-56 cm and older than 9-10 years.

Savvatimsky, P.I. and Vaskov, A.A. 1996. Distribution and biological characteristic of Greenland halibut (*Reinhardtius hippoglossoides*) in the Flemish Pass area and on the Flemish Cape Bank in May 1995. NAFO SCR documents 96/8: 7 p.

Greenland halibut (*Reinhardtius hippoglossoides*) catches did not exceed 850 kg per 3-4 trawling hours and made up insignificant by-catch to redfish at depth to 700m. At 700-900m depth Greenland halibut constituted 86.5% in catches, an essential by-catch of roughhead grenadier. Immature Greenland halibut 35-45cm long at age 4-5 made up the bulk of catches. Mean length of males and females grew with an increase in fishing depth. Feeding intensity was poor. The main components in Greenland halibut feeding were squid, shrimp, Themisto and roughhead grenadier.

Savvatimsky, P.I. and Vaskov, A.A. 1997. Results of Russian surveys on assessment of Greenland halibut stock in the Flemish Pass and on the Flemish Cap in 1996. NAFO SCR documents 97/10: 11 p.

Results of the Russian trawl surveys for Greenland halibut in the Flemish Pass area in February, 1996, and on the Flemish Cap in May are presented. Length-age keys and age composition of Greenland halibut catches in the Flemish Pass are given. The age of males constituted 3 to 13 years old and that of females - 3 to 20 years old. Males at the age of 4-5 and females at the age of 4-6 constituted the basis of catches in that area. A short description of Russian fishery for Greenland halibut in the NAFO area is given.

Savvatimsky, P. I. and Vaskov, A. A. 1998. Results of Russian surveys on Greenland halibut stock assessment on the Flemish Cap in 1987-1996. NAFO SCR documents 98/13: 10 p.

Results of Greenland halibut stock assessment on the Flemish Cap in 1987-1996 are presented. In 1994 trawl survey was not conducted. The calculated abundance and biomass varied considerably by both in separate strata and over the bank on the whole. The main cause of those variations was that research tows covered only the upper part of the distribution range of Greenland halibut. From 1987 to 1994 tows were made down to 731 m, in 1996 to a depth of 914 m. Only immature feeding individuals occurred in catches. Indices of abundance, biomass and catches per effort in the years mentioned above had been reducing and somewhat increasing by 1996, which conforms with variations of those parameters in Divs. 2G and 2H in 1978-1996 and in Divs. 2J and 3K in 1986-1996 from the data of Canadian trawl surveys. Russian surveys showed the increase of Greenland halibut mean length with depth in catches taken on the Flemish Cap, which was noted earlier by various researchers.

Schalinatus, E., Schober, B., Schmidt, U., and Jansen, G. 1991. Untersuchungen zur Isolierung, Charakterisierung und Applikation von proteolytischen Enzymen der Fischeingeweide. 3. Charakterisierung ausgewaehlter Fisch- und Kalmarhaeute und Applikationsversuche zu ihrem Abbau mittels mikrobieller, pflanzlicher, tierischer sowie aus Fischeingeweiden gewonnener proteolytischer Enzyme [Studies on isolation, characterization and application of proteolytic enzymes from fish waste. 3. Characterization of chosen fish- and squid skins and application studies on their degradation by proteolytic enzymes from microorganisms, mammalian pancreas, plants and fish waste]. Fisch. Forsch. 29: 76-82. [In German, English summary]

The proximate amino acid composition of the outer and belly skin of roach, common bream, perch, herring, sardine and salted herring, as well as of the outer and inner skin of squid and the roe bag and egg skin, respectively, of halibut and the roe of rainbow trout was estimated and compared with the data of mammalian collagene. The content (mg/100 mg protein) of the 3 collagenetypical amino acids Gly, Pro and Hypro in all investigated materialist lower than in mammalian collagene: min. 11.6 and 12, respectively, in the egg skin of trout and in the skin of the roe bag of trout, max. 36.9 in the upper skin of roach, more than 50 in mammalian collagene. Lyophilized skin samples of fish and squid as well as native roe bag skin of halibut can be degradated by proteinases produced from fish waste (cod, trout, mirror carr) and by commercially available proteinases from microorganisms, animals and plants.

Schnack, D., Koester, F.W., Rätz, H.J., Wieland, K., Fuerderer, H., Grunwald, E., and Zarkeschwari, N. 1993. Wissenschaftliche Grundlagen fuer oekosystem-orientiertes Fischereimanagement in den Gewaessern vor Groenland [Scientific basis for ecosystem orientated fishery management in the waters near Greenland.]. Berichte aus dem Institut fur Meerskunde an der Christian-Albrechts-Universitat Kiel. 234.133 p. [In German]

Schneider, M., Mandorf, T., and Rubach, K. 1997. Tierartbestimmung von Fisch durch DNA-Analyse mittels RAPD-Technik [Species identification of fishes with DNA-analysis and RAPD-technique]. Dtsch. Lebensm. Rundsch. 93: 137-140. [In German, English summary]

The work presented illustrates a reliable method for differentiating between and identifying the examinated palatable fish species using DNA analysis by means of RAPD fingerprinting. Twenty nine species were compared in the examination. The specific DNA fragment patterns allows reliable species determination not only for raw samples, but also for those which have been deep frozen, heated, or autoclaved. This presents a distinct advantage over isoelectric focussing (IEF) when considering determinations from heated products. RAPD-Fingerprinting using unspecific primers shows a relatively large number of bands, and contains an overload information. Mixtures of two or more fish species give results which are likely to be confusing rather than of the use to the analyst. In this case, when details of the DNA sequence are known, specific primers are to be preferred.

Schoene, R. 1987. Fischereibiologische Untersuchungen und Probennahme auf Fangfabrikschiffen in den Jahren 1985 und (Teil 2) [Fishery investigations and sampling on commercial trawlers in 1985 and 1986. Part 2]. Inf. Fischwirtsch. 34: 4-12. [In German]

Exploratory commercial fishing was performed in 1985 and 1986 in the western Barents Sea (ICES) area IIb), mainly on cod (*Gadus morhua*), haddock (*Melanogrammus aeglefinus*), redfish (*Sebastes marinus* and *S. mentella*) blue whiting (*Micromesistius* *poutassou*) and deep sea shrimp (*Pandalus borealis*). Size and geographical distribution are analysed.

Schoene, R. 1996. Situation wirtschaftlich wichtiger Grundfischbestaende vor Norwegen, Spitzbergn und in der Barents-See [Present status of commercially important groundfish stocks in the Norwegian- and Svalbard-area and in the Barents-Sea]. Inf. Fischwirtsch. 43: 159-162.
[In German, English summary]

Assessments on NE-Arctic stocks of cod *Gadus morhua*, haddock *Melanogrammus aeglefinus*, saithe *Pollachius virens*, redfish Sebastes and Greenland halibut *Rheinhardtius hippoglossoides* were carried out by the ICES "Arctic Fisheries Working Group" in August 1996. Whereas stocks of cod, haddock, and saithe are presently in fairly good and stable condition the assessments show the stocks of beaked redfish and Greenland halibut to bejust the opposite. The status of the golden redfish stock seems to be stable. More detailed information is given in this report

Schoene, R. 1998. Nordostarktische Fischbestaende -- Fangempfehlungen fuer 1998 [North-east Arctic fish stocks -- Scientific advice for catches in 1998]. Inf. Fischwirtsch. 45: 9-12.
[In German, English summary]

The results of the assessments on North-east fish stocks of cod *Gadus morhua*, haddock *Melanogrammus aeglefinus*, saithe *Pollachius virens*, redfish *Sebastes* and Greenland halibut *Rheinhardius hippoglossoides* by the ICES "Arctic Fisheries Working Group" in 1997 are presented. Whereas the stocks of cod; haddock and saithe are considered to be in fairly good conditions and within safe biological limits the assessments show the stocks of beaked redfish and Greenland halibut to be low. Assessments of cod and haddock differed from previous years, because data on cannibalism were introduced into the recruitment models.

Schoene, R. 1999. Fischerei auf die wichtigsten nordostatlantischen Grundfischbestaende 1998 [Fishery on some important groundfishes stocks in the Northeast Atlantic in 1998]. Inf. Fischwirtsch. Fischereiforsch 46: 5-9.
[In German, English summary]

A short review of the actual assessments on the northeast atlantic groundfish stocks of cod (*Gadus morhua*) saithe (*Melanogrammus aegelefinus*), haddock (*Pollachius virens*), redfish (*Sebastes*) and Greenland halibut (*Reinhardtius hippoglossoides*), provided by the ICES "Arctic Fisheries Working Group" is given. All these stocks are presently considered outside safe biological limits. For the first time since 5 years the cod stock is in an endangered situation, because the assessment was to optimistic and the TAC therefore set to high. According to the recent assessments necessary changes in the commercial fishery of the year 1998 off the Norwegian coast and in the Barents-Sea area are discussed. Information on distribution and fishery of cod, haddock, saithe and redfish is given. Biological investigations were carried out onboard the German factory trawler FMS "Kiel" in January/ March and September/October 1998 in order to collect data of the German fishery in that area. Aspects of length and age distributions, and stomach- and gonad investigation are represented.

Schulz, H. 1989. Der Schwarze Heilbutt in der Deutschen Hochseefischerei -- eine Analyse der Anlandetrends [The black halibut and the German deep-sea fishery -- an analysis of the trend of landings]. Inf. Fischwirtsch. 36: 159-160.
[In German]

From 1978 to 1987 an average amount of 91.058 t of black halibut (*Reinhardtius hippoglossoides*) were caught in the world. The German deep-sea fishery amounted to

4.6% (4.164 t). In contrast to the worldwide fishery the German landings of black halibut decreased largely (1978: 6876.7 t, 1987: 622.2 t).

Scott, J.S. and Bray, S.A. 1989. Helminth parasites of the alimentary tract of Atlantic halibut (*Hippoglossus hippoglossus* L.) and Greenland halibut (*Reinhardtius hippoglossoides* (Walbaum)) on the Scotian Shelf. Can. J. Zool. 67: 1476-1481.

Examination of the alimentary tracts of 272 Atlantic halibut (*Hippoglossus hippoglossus* (L.)) and 71 Greenland halibut (*Reinhardtius hippoglossoides* (Walbaum)) from the Scotian Shelf yielded a total of 25 helminth parasite species, 23 from *H. hippoglossus* (16 Digenea, 3 Cestoda, 2 Acanthocephala, 2 Nematoda) and 16 from *R. hippoglossoides* (11 Digenea, 3 Cestoda, 1 Acanthocephala, 1 Nematoda). Parasite prevalence and intensity were low (<50% and <10%, respectively) in both hosts, except for Derogenes varicus and Steganoderma formosum in *H. hippoglossus* and anisakid nematodes in *R. hippoglossoides*. Consideration of change in parasite prevalence and mean intensity in relation to fish length and diet suggests fish prey as transport hosts for D. varicus in larger halibuts, and crustaceans as the intermediate hosts for S. formosum before transmission to its principal host, H. hippoglossus. Geographical change in parasite prevalence and intensity was in the form of southwest to northeast clines along the Shelf, probably related to environmental factors. There was no evidence for stock differentiation in either of the hosts based on parasite fauna.

Sen Tok, K. 2000. On the records of the beshow *Anoplopoma fimbria* (Anoplopomidae) off south-eastern coast of Sakhalin Island. Vopr. Ikhtiol. 40: 709-710.
[In Russian]

Sennikov, A.M., Mukhin, S.G., and Bliznichenko, T.E. 1989. Distribution and trophic importance of juvenile squid (*Gonatus fabricii* Lichtenstein) in the Norwegian and Barents Seas in 1986-1988. ICES CM 1989/K:15: 18 p.

The materials collected in the Norwegian and Barents Seas in summer-autumn 1986-1988 have been analysed. In May-August juvenile *Gonatus fabricii* were distributed predominantly in surface layers of the Norwegian Sea, in the western Barents Sea, and west of Spitzbergen forming concentrations in the frontal zone. Hyperiids, copepods, chaetognaths, and euphausiids were predominant in squid diet.

Serchuk, F., Rivard, D., Casey, J., and Mayo, R. 1997. Report of the Ad hoc Working Group of the NAFO Scientific Council on the precautionary approach. NAFO SCS documents 97/12: 61 p.

Serebryakov, V.P., Chumakov, A.K., and Tevs, I.I. 1989. Spawning stock, population fecundity and year-class strength of Greenland halibut (*Reinhardtius hippoglossoides*) in the Northwest Atlantic, 1969-88. NAFO SCR documents 89/86: 13 p.

An attempt is made to analyze spawning stock abundance and biomass and population fecundity of *Reinhardtius hippoglossoides* against the background of fluctuations in year-class strength. Individual absolute fecundity was calculated, the 1969-1988 year class abundance derived and population fecundity obtained. The survival rate coefficients were used to establish different levels of population fecundity at which the emergence of strong year classes can be provided under various ambient conditions during early life. The fish reproduction capacity was found to be at the equilibrium state in 1969-1988. A close reverse relationship was revealed between survival rate and water temperature at 50-200 m.

Serebryakov, V.P., Chumakov, A.K., and Tevs, I.I. 1992. Spawning stock, population fecundity and year-class strength of Greenland halibut (*Reinhardtius hippoglossoides*) in the

Northwest Atlantic, 1969-88. J. Northwest Atl. Fish. Sci. 14: 107-113.

An attempt was made to analyse spawning stock abundance and population fecundity of Greenland halibut (*Reinhardtius hippoglossoides*) against the background of fluctuations in year-class strength. Population fecundity varied from 8 x 10 super(11) to 24 x 10 super(11) eggs in 1969-88. Survival indices of year-classes 1969-88 were calculated during early life history and a five-fold difference between maximum and minimum survival rates was revealed. An inverse correlation was found between survival rate and water temperature at 50-200 m depth on the hydrographic section across the Hamilton Bank. This was used for survival index projections.

Sevigny, J.M., Archambault, D., and Parent, E. 1992. Genetic variation in Greenland halibut, *Reinhardtius hipoglossoides*, from the St. Lawrence system and the Northwest Atlantic. CAFSAC Res. Doc. 92/99: 21 p.
An allozyme study was conducted to determine if Greenland halibut from the Gulf of St. Lawrence and the Northwest Atlantic area belong to genetically differentiated populations. Genetic variations were studied at 13 loci coding for 10 proteins. Results show a low degree of genetic differentiation in this species. Genetic differentiation among age groups within sampling sites is also weak, suggesting that the observed structure is temporally stable.

Shelton, P.A. 2005. Does the rebuilding plan for Greenland halibut in Subarea 2 and Divisions 3KLMNO have a scientific basis and is it on track? NAFO SCR documents 05/10: 8 p.

The NAFO Subarea 2 and Divisions 3KLMNO Greenland halibut stock is one of the last remaining commercially significant groundfish stocks in the Northwest Atlantic. Exploitable biomass is estimated to be at the lowest level ever and fishing mortality is estimated to be extremely high. The situation is strikingly similar to that of northern cod in the late 1980s. Although NAFO adopted a Precautionary Approach framework in 2004, NAFO also agreed to a Canadian proposal to first test the framework on two relatively healthy stocks before proceeding with actual implementation. Subarea 2 + Divisions 3KLMNO Greenland halibut is therefore not afforded the protection that should occur under the Precautionary Approach at the present time. Instead, NAFO has implemented a rebuilding plan aimed at restoring the exploitable biomass over a period of time. This plan is probably considerably less cautious than one which would be specified under a precautionary approach. In addition, the rebuilding of the stock is not robust to retrospective error in estimates of recruitment nor is it robust to alternative assessment methods applied in the 2004 assessment. Based on the production model estimates from the 2004 assessment and an approach accepted by NAFO Scientific Council for setting Precautionary approach reference points, the stock is below Blim and F is more than 2X Flim.

Shevelev, M.S. and Lepesevich, Y.M. 1991. Results of Soviet investigations of the Norwegian-Barents Sea Greenland halibut stock assessment in 1990. ICES CM 1991/G:24: 14 p.

To assess the Norwegian-Barents Sea Greenland halibut stock, in October-November, 1990 three Soviet research vessels conducted a directed stratified trawl survey for the first time. From the survey the abundfance and biomass of Greenland halibut over the covered area were estimated to 59x10(6) fish and 55,000 t, respectively. Fish ranged from 36 to 55 cm in length at age 4-7 were predominant in catches on the whole area surveyed. Catches consist mainly of recruits, that indicates the depletion of commercial stock. It was found that factors responsible for formation of unstable commercial concentrations of Greenland halibut in October-December, 1990 are the following: low level of commercial and spawning stocks, shift in age-length structure towards younger ages, and also higher heat content of waters of the Bear Island-Spitsbergen area, that resulted in delayed rates of the spawning migration.

Shleinik, V.N. 1999. Biologiya i regulirovanie promysla donnykh ryb Barentseva morya i Severnoj Atlantiki [Biology and regulation of fisheries of demersal fish in the Barents Sea and the North Atlantic]. Izd-vo PINRO, Murmansk (Russia). 163 p.
[In Russian, English summary]
The results of the Barents Sea fish studies, namely Atlantic cod *Gadus morhua,* haddock *Melanogrammus aeglefinus,* Greenland halibut *Reinhardtius hippoglossoides* and redfish *Sebastes mentella,* are presented. Forecasting of year class abundance, stock size modelling and fisheries regulation on the basis of the ecosystem approach are discussed. New data on formation of redfish aggregations in the Irminger Sea and on maturation of lumpsucker *Cyclopterus lumpus* in the Barents Sea are also given.

Shuntov, V.P. 1980. The distribution of Greenland halibut, arrowtooth and Kamchatka flounder in the northern part of the Pacific Ocean. Can. Transl. Fish. Aquat. Sci. 4644: 18 p. [Translated from Russian; Original appeared in: Izvestiya Tikhookeanskogo nauchno-issledovatel'skogo Instituta rybnogo khozyaistva i okeanografii (TINRO). 53: 155-161, 1965]

The investigations showed that the geographic distribution of the species studied is determined by a complex of different factors. The northern and southern boundaries of the distribution of halibut in the northern part of the Pacific Ocean are determined to a large extent by water temperature.

Shvagzhdis, A.P. 1990. Feeding peculiarities of Greenland halibut from the Norwegian-Barents Sea stock in 1980-1989. ICES CM 1990/G:12: 19 p.

In 1980-1989 in total 43304 stomachs of Greenland halibut from the Norwegian-Barents Sea stock have been examined by field analysis. Different species of small-sized fishes, with capelin, polar cod and young redfish being predominant, made up the bulk of feeding by a frequency of occurrence of food items. Crustaceans, mainly northern shrimp, were at the second place, and at the third one -Cephalopoda. food composition and frequency of occurrence of food items varied both by individual areas and years. Fish were most frequent in Greenland halibut feeding in the feeding areas, northern shrimp and squid - on the spawning grounds. A direct relationship between the degree of stomach fullness and frequency of occurrence of main food items was elucidated; the higher the frequency of fish prey occurrence is, the higher the mean degree of stomach fullness. in 80s, compared to 60s, some variations have been registered in Greenland halibut feeding, i.e. frequency of occurrence of fish prey and Cephalopoda had reduced and a portion of crustaceans increased. Decrease in frequency of occurrence of capelin, polar cod and young gadoid species is a consequence of their reduction.

Siegstad, H. 1992. Denmark/Greenland research report for 1991. NAFO SCS documents 92/19: 5 p.

Siegstad, H. 2000. Denmark/Greenland research report for 1999. NAFO SCS documents 00/22: 5 p.

Siegstad, H. 2001. Denmark/Greenland research report for 2000. NAFO SCS documents 01/21: 7 p.

Siegstad, H. 2002. Denmark/Greenland research report for 2001. NAFO SCS documents 02/16: 9 p.

Siegstad, H. 2004. Denmark/Greenland research report for 2003. NAFO SCS documents 04/14: 8 p.

Siegstad, H. 2005. Denmark/Greenland research report for 2004. NAFO SCS documents 05/14: 9 p.

Siegstad, H. and Frandsen, R.P. 2003. Denmark/Greenland research report for 2002. NAFO SCS documents 03/16: 7 p.

Sigaev, I.K. and Rikhter, V.A. 1999. Russian research report for 1998. NAFO SCS documents 99/5: 13 p.

Sigaev, I.K. and Rikhter, V.A. 2004. Russian research report for 2003. NAFO SCS documents 04/3: 24 p.

Sigaev, I.K. and Rikhter, V.A. 2005. Russian research report for 2004. NAFO SCS documents 05/5: 22 p.

Sigaev, I.K., Rikhter, V.A., Gasiukov, P.S., Vaskov, A.A., Igashov, T.M., and Kiseleva, V.M. 2000. Russian research report for 1999. NAFO SCS documents 00/9: 22 p.

Sigurdsson, A. 1977. On the spawning grounds of Greenland halibut in Icelandic waters. ICES CM 1977/F:28: 11 p.

Sigurdsson, A. 1981. Migrations of Greenland halibut *Reinhardtius hippoglossoides* (Walb.) from Iceland to Norway. Rit Fiskid. 4: 3-6.

Sigurdsson, A. and Magnusson, J.V. 1980. Nursery grounds of the Greenland halibut spawning in Icelandic waters. ICES CM 1980/G:45 : 8 p.

It is reported on Greenland halibut smaller than 20 cm found off the north coast of Iceland, which until now have not been observed in Icelandic waters. Further, the drift and the size of 0-group Greenland halibut in the years 1970 to 1979 are described.

Simonsen, C.S. 1997. Denmark/Greenland research report for 1996. NAFO SCS documents 97/11: 6 p.

Simonsen, C.S. 1998. An assessment of the Greenland halibut stock component in NAFO Division 1A inshore. NAFO SCR documents 98/44: 18 p.

The Greenland halibut (*Reinhardtius hippoglossoides*) stock component in Div. 1A inshore is considered as a separate part of the Davis Strait stock. The component probably does not contribute to the spawning stock in Davis Strait and only sporadical spawning is observed in the inshore area. Hence, the inshore component is not assumed to be a self-sustainable stock, but dependent on recruitment from the nursery area south of Disko Island. Concern is expressed by the continuing increase in total landings of Greenland halibut in NAFO Div. 1A inshore, especially because lack of information from the commercial fishery impedes the assessment of stocks.

Simonsen, C.S. 1998. Denmark/Greenland research report for 1997. NAFO SCS documents 98/14: 6 p.

Simonsen, C.S. 2002. An assessment of the Greenland halibut stock component in NAFO Division 1A inshore. NAFO SCR documents 02/55: 23 p.

This paper presents the assessment of Greenland halibut (*Reinhardtius hippoglossoides*) in the inshore part of NAFO Div. 1A. The area covers the fjords in the three distinctive geographical areas, Disko Bay, Uummannaq and Upernavik. Information from the commercial fishery (only landings, no effort information) and research survey (longline

survey in two of the three areas in rotation, approximately, 30 fixed stations in each area) were available for the assessment. Catch-at-age data for each of the three inshore areas were available from the fishery covering area, gear and season. The assessments were as follows. Disko Bay: For a period of more than 10 years landings more or less increased annually from about 2 000 tons in 1987 to 10 500 tons in 1998 and 1999. Since then landings have declined and last year were 7 072 tons. Long-line survey results since 1993 do indicate stable abundance indices until 2000. CPUE in 2001 is much higher although uncertain. Length composition in both commercial and survey information indicate strong recruiting year-classes coming into the survey in 2000. Estimates on fishing mortality (F) indicate that F has increased in the entire period. Uummannaq: Catches have been increasing from less than 2 000 tons before 1987 to a record high in 1999 of 8 425 tons. Since then landings have declined to 6 558 tons in 2001. Mean lengths in survey have been stable in the entire period. Survey abundance peaked in 1999 and has since decreased to the same level as in 1996. Catch at age composition in the commercial fishery has changed significantly since the 1980s towards a higher exploitation of younger age-groups, but have been stable in recent years. Length distribution in the winter fishery has been increasing in 2002, while the summer fishery has been stable. Estimates on F indicate that F has been relatively stable. Upernavik: Landings have increased from about 1 000 tons prior to 1992 to about 5 000 tons in 1996 and 1997. In 1998 landings were the highest on record, 7 012 tons. Since then landings have decreased by 50%. Survey results indicate a fall in abundance since 1994. Size and age distribution have changed to smaller fish but stabilized in recent years. Estimates on fishing mortality F indicate that continuing increase in F. New fishing grounds in the northern part of the district are being exploited, however, little information exists from these areas.

Simonsen, C.S. and Boje, J.1997. An assessment of the inshore Greenland halibut stock component in NAFO Division 1A. NAFO SCR documents 97/78: 15 p.

The main inshore fishing grounds for Greenland halibut (*Reinhardtius hippoglossoides)* are in Div. 1A where the total landings amounted to 17,262 tons in 1996, comprising 98.74% of the total inshore landings in Greenland. In 1996 catches were rather evenly distributed over the year with a tendency toward higher catches around August. A total ban on gillnets is in force from 1998. The gillnet fishery in 1996 was regulated by a minimum mesh-size of 110 mm while there are no regulations on longline fisheries. The inshore fishery in Div. 1A is located in three main areas: Disko Bay, Uummannaq and Upernavik and there are no quotas on the fishery.

Simonsen, C.S. and Boje, J.1999. An assessment of the Greenland halibut component in NAFO Division 1A inshore. NAFO SCR documents 98/48: 24 p.

The Greenland halibut (*Reinhardtius hippoglossoides*) stock component in Division 1A inshore is considered as a separate part of the Davis Strait stock. The component probably doesn't contribute to the spawning stock in Davis Strait and only sporadic spawning is observed in the inshore area. The inshore component is not assumed to be a self-sustainable stock, but dependent on recruitment from the nursery area south of Disko Island. The main inshore fishing grounds for Greenland halibut are in Div. 1A, where the total landings amounted to 24,594 tons in 1998, and comprised 99.6% of the total inshore landings in Greenland. The inshore landings in Div. 1A were around 7,000 tons in the late 1980s, but have since increased steadily. The inshore stocks depend on recruitment from the offshore nursery grounds and the spawning stock in Davis Strait. Available information suggests that spawning only occurs sporadically in the fjords, hence the stock is not self-sustainable. The fish remain in the fjords, and do not contribute to the offshore spawning stock. Provisional studies of the by-catch of Greenland halibut in the commercial shrimp fishery suggest that the by-catch is considerable and could have a negative effect on the inshore stock component. Direct measurement of effort should be provided. This would make it possible to obtain estimates of Z from the commercial fishery. Trends in effort could be compared to trends in F. There are strong indications that effort has increased in recent years. Logbooks will be introduced in the near future for parts of the inshore Greenland halibut fishery, so hopefully effort-values will soon be available.

Simonsen, C.S. and Boje, J. 2000. An assessment of the Greenland halibut stock component in NAFO Division 1A inshore. NAFO SCR documents 00/47: 36 p.

The Greenland halibut (*Reinhardtius hipploglossoides*) stock component in Div. 1A inshore is considered to be recruited from Davis Strait stock, but the adults appear to be isolated from their original spawning stock. Thus, the components probably do not contribute to the spawning stock in Davis Strait and only sporadic spawning is observed in the inshore area. Hence, the inshore component is not assumed to be a self-sustainable stock, but dependent on immigration from the nursery area south of Disko Island. There is concern expressed about the continuing increase in total landings of Greenland halibut in Div. 1A inshore especially because lack of information from the commercial fishery impedes the assessment of stocks. Logbooks have just been introduced for parts of the inshore Greenland halibut fishery and will hopefully provide support to future assessments.

Simonsen, C.S. and Boje, J. 2001. An assessment of the Greenland halibut stock component in NAFO Division 1A inshore. NAFO SCR documents 01/68: 37 p.

This paper presents the assessment of Greenland halibut in the inshore part NAFO Div. 1A. The area covers the fjords in Disko Bay, Uummannaq and Upernavik. Information from the commercial fishery and research survey were available for the assessment. Catch-at-age data for each of the three inshore areas were available from the fishery covering area, gear and season. The research survey is conducted using longline, two of the three areas in rotation are surveyed with approximately 30 fixed stations in each area. The assessments were as follows: Disko Bay; estimate of fishing mortality has shown a generally increasing trend from late 1980s to present. Survey results from 1993 onwards do not indicate any major changes in abundance. Mean length composition in the survey has been stable in recent decades. The survey in 2000 did, however, show a decline in mean length in Torssukataq. In the commercial fishery the mean length in the summer fishery has been relatively stable while an increase has been observed in the winter fishery. Uummannaq; survey results from 1993 onwards do not indicate any major changes in abundance. Catch composition in the commercial fishery has changed significantly since the 1980s towards a higher exploitation of younger age groups, but has recently stabilized. Upernavik; survey results from 1993 to 99 have fluctuated without trend but the 2000 survey indicated reduction in abundance. Mean length compositions in both commercial and survey catches have decreased, most significantly in the winter fishery. In the traditional fishing grounds at Upernavik up to 73 degree 24N younger and fewer age groups are caught. New fishing grounds in the northern part of the district have been exploited only recently. Little information exists from these areas and the stock components are considered virgin.

Simonsen, C.S. and Boje, J. 2003. An assessment of the Greenland halibut stock component in NAFO Division 1A inshore. NAFO SCR documents 03/49: 22 p.

This paper presents the assessment of Greenland halibut (*Reinhardtius hippoglossoides)* in the inshore part of NAFO Div. 1A. The area covers the fjords in the three distinctive geographical areas, Disko Bay, Uummannaq and Upernavik. Thhe preliminary assessments were as follows. Disko Bay: For a period of more than 10 years landings more or less increased anually from about 2 000 tons in 1987 to 10 500 tons in 1998 and 1999. In 2000 and 2001 landings declined to about 7 000 tons but increases abruptly to a record high of 12 000 tons in 2002. Long-line survey results since 1993 to indicate stable abundance until 2000. CPUE in 2001 is remarkably higher although uncertain. Length composition in both commercial catches and survey indicates strong recruiting year-classes coming into the survey in 2000. Estimates on fishing mortality (F) indicate that F has increased in the entire period. Uummannaq: Catches have been increasing from less than 2000 before 1987 to a record high in 1999 of 8425 tons. Since then landings have declined to 5339 tons in 2002. Mean lengths in survey have been stable in the entire period. Survey abundance peaked in 1999 and has since decreased to the same level as in 1996. Catch at age composition in the commercial fishery has changed significantly since the 1980s towards a higher exploitation of younger age-groups, but have been stable in recent years up to 2001. Length distribution in the winter fishery has been increasing in 2002, but dropped again in 2003, while the length distribution in the summer fishery has been stable. Estimates on F indicate that F has been relatively stable. Upernavik: Landings have increased from about 1000 tons prior to 1992 to about 5000 tons in 1996 and 1997. In 1998 landings were the highest on record, 7012 tons. Since then landings have decreased by more than 50% to 3019 tons in 2002. Survey results indicate a decline in abundance since 1994 but a stabilization in recent years. Size and age distribution have changed to smaller fish but also stabilized in recent years. Estimates on fishing mortality F indicate that continuing increase in F until 2001. New fishing grounds in the northern part of the district are being exploited; however, little information exists from these areas.

Simonsen, C.S. and Gundersen, A.C. 2002. Maturity of Greenland halibut (*Reinhardtius hippoglossoides*) in the fjords of Northwest Greenland. NAFO SCR documents 02/38: 12 p.

In order to clarify the spawning of Greenland halibut (*Reinhardtius hippoglossoides*) in the fjords of West Greenland a study was performed on the maturity of Greenland halibut in Disko Bay. The goals were to: 1) Describe the maturity of the female fish throughout the year by looking at the oocyte development month by month. 2) If growth in maturity was observed, then locate the time of spawning. 3) To quantify the amount of fish participating in the fjord spawning. Each month up to 60 fish bigger than 70 cm were random sampled from the commercial landings. The relation between gonad and fish weight was used to set up a gonadosomatic index. The oocyte development was followed month by month by diameter analysis. Due to sampling failure from June and onwards it was not possible to give a yearly maturation cycle for the oocytes of the Greenland halibut in Disko Bay. There was no clear evidence of an overall increase in gonad weight during the four months investigated. The gonad index indicated that most ovaries were in an immature or early maturing stage. However, when looking at the oocyte development month by month a weak trend toward an increase in the oocyte size was evident with respect to the diameter range of the leading cohort. If spawning is happening in Disko Bay it is believed that the most likely period for any extensive spawning is the same as in the Barents Sea namely November-January. Based on the available data it was not possible to quantify the proportion of Greenland halibut in Disko Bay participating in such a spawning event.

Simonsen, C.S. and Gundersen, A.C. 2002. Maturity of Greenland halibut (*Reinhardtius hippoglossoides*) in the fjords of Northwest Greenland. *In* Reproduction of West-Nordic Greenland halibut. Studies reflecting on maturity, fecundity, spawning and TEP. *Edited by* A.C.Gundersen. Nordic Council of Ministers, Copenhagen (Denmark). pp. 97-116.

Due to sampling failure from June and onwards we were not able to give a yearly maturation cycle for the oocytes of the Greenland halibut in Disko Bay. There was no clear evidence to an overall increase in gonad weight in during the four months investigated. Gonad index indicated that most ovaries were in an immature or early maturing stage. However, when looking at the oocyte development month by month a weak trend to an increase in the oocyte size was evident with respect to the diameter range of the leading cohort. If spawning is happening in Disko Bay we believe that the most likely period for any extensive spawning is the same as in the Barents Sea namely November-January. Based on the available data we were not able to quantify the proportion of Greenland halibut in Disko Bay participating in such a spawning event. We believe that further studies are needed in order to clarify the spawning and sexual maturation of the Greenland halibut in the inshore stock components in West Greenland. A suited method would be a gillnet survey, (using mesh-size 200--240 mm) conducted monthly in the period August to January. Spawning frequency, oocyte development, atresia, and the actual number of eggs produced are important in that respect. Identifications of separate spawning entities contributes to better understanding of general reproductive capacity, and gives further indications on where nursery grounds for the juveniles may be located. Due to the wide distribution of Greenland halibut in the Atlantic it is important to link collected information to abiotic factors, to be able to explain possible differences in reproductive strategy within the species.

Simonsen, C.S. and Gundersen, A.C. 2005. Ovary development in Greenland halibut *Reinhardtius hippoglossoides* in west Greenland waters. J. Fish Biol. 67: 1299-1317.

Maturity in adult female Greenland halibut *Reinhardtius hippoglossoides* was studied in three areas in west Greenland waters: the inshore area in Disko Bay and two offshore areas, Baffin Bay and Davis Strait. The aim was to monitor maturity changes in the inshore fjords of Disko Bay over an extended period from winter to autumn and compare these findings with specimens from Baffin Bay and the presumed spawning area in Davis Strait. A significant difference in maturity level was observed in and between the three areas. In Disko Bay maturity indices increased significantly in August and September both with respect to the gonado-somatic index (I-G) and the size in the leading oocyte cohort. In the period February to May no significant changes were observed. Mature ovaries were only observed among fish >80 cm total length and only among a fraction of these large fish. Offshore areas of Baffin Bay, even though poorly sampled, showed similar signs in the maturity indices as in Disko Bay. Relative to Disko Bay and Baffin Bay, female fish in Davis Strait had more progressed maturity indices. Furthermore, almost all fish in Davis Strait showed signs of progressed maturity contrary to Disko and Baffin Bay. A large proportion of the Greenland halibut in Disko and Baffin Bay apparently did not begin the maturation cycle until very late in their life history or were repeat spawners with a multi-year maturation cycle. These observations could thus support the hypothesis that Greenland halibut have a prolonged adolescent phase. Atresia was highest in the early phases of maturation in Greenland halibut but relatively high levels of atresia were also observed in fish in more advanced maturity phase. The first was ascribed to fecundity regulation while the latter could be linked to the fish's fitness condition but it was not possible to show this with the available condition index.

Simonsen, C.S. and Treble, M.A. 2001. Tagging mortality of Greenland halibut, *Reinhardtius hippoglossoides* (Walbaum). NAFO SCR documents 01/130: 15 p.

Tagging mortality for Greenland halibut was studied under summer and winter conditions. The fish were caught using longlines and tagged with a T-bar tag. The winter experiment was conducted in Cumberland Sound, Canada in May 1997. Air temperatures were below 0 deg C and cold water-masses were present at 0-300 m. Fish were immediately placed in a tub of water after capture and transported by snowmobile to a heated tent for tagging and then placed in cages that were submerged to 300 m depth. The summer experiment was conduted in Upernavik, Greenland in August 1998. Air temperatures were above 0 deg C but intermediate cold water-masses were present at 50-200 m. In the summer experiment fish were tagged and released in a holding tank to assess immediate tagging mortality, placed in specially designed cages and submerged to 200-500 m to assess short-term tagging mortality. A total of 155 Greenland halibut were included in the study. Overall tagging mortality was estimated to be 7%. Immediate handling and tagging mortality in both the winter and summer experiments was low. Several factors were shown to have significant effects on the outcome. Fish held in the tanks for longer time periods were in better condition. Moreover, females had a tendency to be in poorer condtiion than males immediately following tagging. Short-term mortality was 4%. There was no difference in mortality rates between seasons. There was no effect on mortality of the covariates size, time held in the cage and several other factors examined. However, there was a significant correlation between the fish's health and mortality. The study showed that tagging under harsh winter conditions is just as possible as under summer conditions as long as exposure to sub-zero temperatures are minimized. Our study further suggests that holding the tagged fish in an observation tank for a period of 5h or more could reduce the tagging mortality on released fish.

Simonsen, C.S. and Treble, M.A. 2003. Tagging mortality of Greenland halibut *Reinhardtius hippoglossoides* (Walbaum). J. Northwest Atl. Fish. Sci. 31: 373-385.

Tagging mortality for Greenland halibut (*Rainhardtius hippoglossoides*) was studied under summer and winter conditions. The fish were caught using longlines and tagged with a T-bar tag. The winter experiment was conducted in Cumberland Sound, Canada in May 1997. Air temperatures were below 0 degree C and cold water-masses were present at 0-300 m. Fish were immediately placed in a tub of water after capture and transported by snowmobile to a heated tent for tagging and then placed in cages that were submerged to 300 m depth. The summer experiment was conducted in Upernavik, Greenland in August 1998. Air temperatures were above 0 degree C but intermediate cold water-masses were present at 60-200 m. In the summer experiment, fish were tagged and released in an observation tank to assess immediate tagging mortality (1 to 18 hr). They were then placed in specially designed cages and submerged to 300-500 m to assess short-term tagging mortality (up to 117 hr). A total of 155 Greenland halibut were included in the study. Overall tagging mortality was estimated to be 7%. Immediate handling and tagging mortality in both winter and summer experiments was low (<5%). Several factors were shown to have significant effects on the outcome (level of condition). Fish held in the tanks for longer time periods were in better condition. Females had a tendency to be in poorer condition than males immediately following tagging. Overall short-term mortality was 4%. There was no significant difference in mortality rates between seasons. There was no effect on mortality of the covariates size, time held in the cage and several other factors examined, but overall mortality was so low that differences would be difficult to detect. However, there was a significant correlation between the fish condition and mortality. The study showed that tagging under harsh winter conditions is just as possible as under summer conditions as long as exposure to sub-zero air/water temperatures are minimized. The study further suggests that holding the tagged fish in an observation tank for a period of 5 hr or more could reduce the tagging mortality on released fish.

Simonsen, C.S., Boje, J., and Kingsley, M.C.S. 2000. A review using longlining to survey fish populations with special emphasis on an inshore longline survey for Greenland halibut (*Reinhardtius hippoglossoides*) in west Greenland, NAFO Division 1A. NAFO SCR documents 00/29: 25 p.

In this paper we present a review on the use of longline surveys for stock assessment of Greenland halibut in the fjords of Northwest Greenland. We examined the different factors that could influence catch rate and analysed the variability in catch rates both with regard to time and space. Within station variance was analysed by examining repeated settings and settings with subdivided lines. Variability in catch rates was found just as high within sttions as between adjacent stations. Of other factors that influenced the catch rate of Greenland halibut was subarea and year. By means of cluster analysis, we found that some areas showed consistent higher catch rate than others. The presence of other species did not influence catch rate, but big and small Greenland halibut seemed positively correlated. Analyses of the CPUE in relation to time of day point to that Greenland halibut is just as active feeding at night as at day.

Skuladottir, U. 1997. The by-catch in the shrimp fishery of Iceland at Flemish Cap in 1996 and 1997. NAFO SCR documents 97/80: 4 p.

The bycatch in the northern shrimp (*Pandalus borealis*) fishery at Flemish Cap has become less serious since the distance between bars in the Nordmoor grate was reduced from 28 mm to 22 mm. The Icelandic Observer Scheme was initiated in January 1996. Since then there has been one observer per each Icelandic shrimp vessel observing the catch. Only preliminary data is presented here as 6-7 Icelandic vessels were still fishing at Flemish Cap and were not able to send data to Iceland. No Atlantic cod, *Gadus morhua* was seen in the catch. For the year 1997 the bycatch recorded was: redfish, *Sebastes*--0.4 to 0.61%; Greenland halibut, *Reinhardtius hippoglossoides*--0-0.1%; wolffish, *Anarhichus*--0.3%. These figures represent a reduction in the 1996 bycatch.

Skuladottir, U. 1998. The bycatch in the shrimp fishery of Iceland in Flemish Cap in 1997 and 1998. NAFO SCR documents 98/29: 5 p.

This paper presents data collected by observers on bycatch onboard Icelandic vessels. The three species detected in the bycatch in the northern shrimp (*Pandalus borealis*) fishery at Flemish Cap were redfish (*Sebastes*), Greenland halibut (*Reinhardtius hippoglossoides*), and wolffish (*Anarhichas*). The overall percentage of bycatch by weight was 1.8% in 1997 compared to 3% in 1996. Of this, redfish accounted for 1.4%. The difference lies mainly in the greater number of wolffish in 1996. The bycatch in the shrimp fishery at Flemish Cap has become less serious when the distance between bars in the Nordmoor grate were reduced from 28 mm to 22 mm.

Skuladottir, U. 2003. The by-catch in the shrimp fishery of Iceland at Flemish Cap in 1996-2003. NAFO SCR documents 03/84.

The data presented are collected by observers onboard Icelandic vessels all year round at Flemish Cap in years 1996-2003. There are mainly three species in the by-catch of the shrimp fishery, Greenland halibut (*Reinhardtius hippoglossoides*), wolffish (*Anarhichas lupus*) and redfish (*Sebastes mentella*), where redfish is the most prevalent. The redfish by-catch has fallen from 1.6% in 1996 to 0.26% and 0.32% in years 2002 and 2003, respectively. Cod (*Gadus morhua*) was only detected in 1999 and American plaice (*Hippoglossoides platessoides)* in very small numbers. The by-catch as a whole was about 0.3% in the years 2002 and 2003, 0.8% in 2001 and 0.9% in 2000 as compared to 1% of the shrimp catch in 1999, 8% in 1998, 1.8% in 1997 and 2% in 1996. Most of this was redfish or 0.7-0.8% in the years 1999 to 2001. Other species were wolffish, Greenland halibut and American plaice. Cod was seen for the first and only time in April 1999, but has not been seen since as by-catch. If all vessels in the shrimp fishery of Flemish Cap were fishing at the same rate as Icelanders then as much as 124 to 774 tons would have been caught annually, the peak being in 1996.

Skuladottir, U. and Jonsson, S.T. 1991. A preliminary report on the predation on the shrimp, *Pandalus borealis*, by Greenland halibut, *Reinhardtius hippoglossoides*, off north and east Iceland. ICES CM 1991/K:6: 11 p.

The stomach contents of some Greenland halibut in the bycatch in the offshore *Pandalus* surveys during the years 1987- 1989 was studied and evaluated qualitatively, i.e., by counting the number of each prey item. These were in few cases identified to species as for example the shrimps but often to families like the Euphausids. A preliminary attempt was made to evaluate the prey quantitatively. The area north and east of Iceland was divided into three areas as there seemed to be some differences in diet composition among areas. The main results were that by number the occurrence of the shrimp *Pandalus borealis* was 1.4% in the western-most area, 9% in the northeast area and 31% in the eastern-most area. The shrimp *Hymenodora glacialis* was 75% in the western-most area but only 7% in the northeast area and not found at all in the eastern-most area. The Euphausids were very common ranging from 13.5% in the west to 59% in the northeast. The number of fish was considerable in the northeast and in the east or 22 and 25% respectively. Although the weighing of fish was seldom carried out, the proportion by weight gives a rough idea. Here fish becomes the most important ranging from 61% in the western-most area to 84% in the northeast. Of these *Mallotus villosus* is by far most frequently found. *H. glacialis* is then 33.5% in the west and about 2% in the northeast area by weight. *P. borealis* is 3% in the west and about 2% in the northeast area by weight. *P. borealis* is 3% in the west, 8% in the northeast and 24% in the eastern-most area by weight. It can be said that fish is the most important prey. The high occurrence of *H. glacialis* in the west where it is readily available although less numerous than *P. borealis* in the catch, points to a preference for *H. glacialis* to *P. borealis*.

Smidt, E. 1969. The Greenland halibut in Greenland waters. ICES CM 1969/F:20: 3 p.

Smidt, E. 1974. Notes on the distribution of Greenland halibut in the Northwest Atlantic. ICNAF Res. Doc. 74/84: 4 p.

Smidt, E. 1974. The Greenland halibut. Can. Transl. Fish. Aquat. Sci. 3094: 40 p. [Translated from Danish; original appeared in: Tidsskrifted Gronland. Dec. f1969, pp. 259-366]

An overview of the Greenland halibut in Denmark, including biological data, fishing methods, experimental fishing, feeding behaviour, handling and processing of the catch, and the outlook for the future of the fishery.

Smidt, E. 1981. Denmark (Greenland) research report for 1980. NAFO SCS documents 83/VI/12: 25 p.

Smidt, E. 1984. Denmark (Greenland) research report for 1983. NAFO SCS documents 80/VI/16: 17 p.

Smidt, E. 1985. Denmark (Greenland) research report for 1984. NAFO SCS documents 85/17: 15 p.

Smidt, E.L.B. 1967. The Greenland halibut, *Reinhardtius hippoglossoides* (Walb.), biology and exploitation in Greenland waters. Meddelelser fra Danmarks fisker- og havundersogelser. NY serie 6: 79-148.

Smirnov, O.V. 1996. Stock status of Norwegian-Barents Sea population of Greenland halibut (*Reinhardtius hippoglossoides* Walbaum) by the data from Russian trawl surveys for 1990-1995. ICES CM 1996/G:42: 14 p.

By the data from trawl surveys for 1990-1995 the abundance of Greenland halibut (*Reinhardtius hippoglossoides*) in the areas of its main aggregations over 140 thou. sq. miles has been calculated. In 1990-1992 a growth in its abundance was observed from 62 to 100 mill. spec., and further a drop to 55-58 mill. spec. followed in 1994-1995. As a result of a constant reduction in number of juveniles from 1990 to 1995 a growth in mean age, length and weight of specimens was registered. A trend of reduction in a portion of females from commercial stock was observed from 49-59 % in 1990-1991 to 33-41 % in 1993-1995. The abundance of mature females from spawning stock, at its increase from 20 mill. spec. in 1990-1991 to 40-34 mill. spec. in 1993-1995, grew from 4 to 8 mill. spec. during the period of 1990-1994 and further in 1995 reduced again to 5 mill. spec. Results from the investigations have indicated the fisheries restrictions existing since 1992 to be insufficient to settle problems on the population recovery. Increase of a portion of passive fishing gears during a halibut total catch in 1992-1994 provides a main withdrawal of large mature specimens what retards greatly the growth of spawning stock, population fecundity and, hence, restricts the next yearclasses abundance. Introduction of ban on Greenland halibut direct fishery by any fishing gears could be a measure allowing suspending further reduction of stocks.

Smirnov, O.V. 1998. Dynamics of population fecundity of Greenland halibut (*Reinhardtius hippoglossoides*) of the Norwegian-Barents Sea stock by the data from 1984-1997 trawl surveys. ICES CM 1998/O:16: 9 p.

Population fecundity indices were calculated for period 1984-1997 using the data from trawl surveys. Highest level of population fecundity occurred in the beginning of time series. Lowest indices (25-30% of 1984-1985 level) have been obtained in 1987-1992. In 1993-1997 population fecundity increased significantly but remained at level twice as low compared to 1984-1985 level. On the ground of the population fecundity analysis, it is supposed that real growth of the Greenland halibut commercial stock owing to rising of recruitment is likely to begin in 2002-2004.

Smirnov, O.V., Shevelev, M.S., and Lepesevich, Y.M. 1993. Results of Russian investigations of Greenland halibut from the Norwegian-Barents Sea stock in 1992. ICES CM 1993/G:59: 16 p.

The usual stratified trawl survey for Greenland halibut from the Norwegian-Barents Sea stock was carried out by three Russian research vessels in October-November 1992. Term and area of operation were similar to those in 1991. The abundance and biomass of Greenland halibut over the area surveyed were estimated to be 72 mill. fish and 77,000 tons, respectively. Besides, 20 mill. fish with biomass of 19 000 tons were supposed to be distributed over the area, non-covered due to technical reasons. Despite some increase against 1991, the stock is at a low level now. The catches of Greenland halibut were dominated by fish at age 4-7, 36-55 cm long. Greenland halibut migration to spawning and wintering grounds in 1992 were registered to be earlier than in 1991, approximately, in the end of October- beginning of November.

Smirnov, O.V., Lepesevich, Y.M., and Shevelev, M.S. 1994. Results of Russian investigations for Greenland halibut from the Norwegian/Barents Sea stock in 1993. ICES CM 1994/G:31: 12 p.

In November-December 1993 two Russian research vessels carried out a regular stratified survey for Greenland halibut stock from the Norwegian Barents Seas population. The densest concentrations of Greenland halibut were registered over the continental slope where the species was spawning during the survey period. Individuals of 40-45 cm long at age 4-7 years were predominant over the whole area. Mean length of halibut in 1993 was larger compared with that in 1991-1992. Halibut abundance over the area investigated has been assessed at 54.5 mill. spec. and 69 thou. t of biomass. Besides, 8.2 mill. spec. or 9.6 thou. t seemed to be distributed over the area not covered by investigationsl thus, halibut stock over the study area at the end of 1993 was at a stable low level and made up about 63 mill. spec. or 79 thou. t.

Smith, G.B., Hadley, R.S., French, R., Nelson, R., and Wall, J. 1980. A summary of productive foreign fishing locations in the Alaska Region during 1977-79: longline fisheries. Alaska Sea Grant report 80-1: 180 p.

Data resulting from U.S. observer coverage of foreign longline fishing activities in the Alaska region during 1977-79 are reported in ways intended to enhance the transfer of information to the U.S. fishing industry. A total of 1327 longline set records were available from the three years of monitoring, representing coverage of 8 to 22 percent of the total longline fishing effort during any one year. The most productive foreign fishing locations are described for five important fish groups, in four major geographical regions.

Smoker, J. 1994. Management of bycatch in hook-and-line groundfish fisheries off Alaska. *In* Bycatch in fisheries and their impact on the ecosystem. *Edited by* T.J.Pitcher and R.Chuenpagdee. Vancouver, B.C. pp. 45-48.

In 1993, hook-and-line gear took 90% of sablefish, *Anoplopoma fimbria*, 34% of Pacific cod, *Gadus macrocephalus*, and 86% of Greenland turbot, *Reinhardtius hippoglossoides*, in the EEZ off Alaska. The principal bycatch species is halibut, *Hippoglossus stenolepis*. In the Bering Sea and Aleutian Islands area 13% of total groundfish-fishery-induced halibut mortality was from hook-and-line gear, and in the Gulf, 41%. Several different approaches to reduce such halibut mortality have been made in the last few years. In 1993 the Gulf Plan Team recommended the following as general methods to control bycatch: incentive programs, timing of groundfish seasons, and seasonal apportionment of halibut PSC limits. The Team also suggested that license limitations would reduce halibut bycatch. Control of halibut bycatch in hook-and-line fisheries off Alaska is effected by a combination of regulatory-imposed and independently operated programs. Key to the success of both is the proper collection, analysis and prompt dissemination of information to fishermen and managers alike.

Sokolov, K.M. 1995. Restriction of young fish by-catches as one of fishery management measures. ICES CM 1995/S:12: 9 p.

Recently developed methods of calculation of allowable by-catches of young commercial fish species of the Barents and Norwegian Seas during different fisheries including shrimp harvesting are analyzed. Values of allowable by-catches of young fish during the shrimp fishery, calculated by different methods, are compared, and the priority of a biological method is proved. The supposed economical losses of young fish during shrimp fishery is estimated. Expedience of the further work on developing and combination of biological and bioeconomical approaches to calculations of allowable by-catches of young commercial fish species is proved as a fishery managing measure. Necessity of changing an approach to a restriction of young fish by-catches as fishery management measure has arisen in recent years due to variations in conditions of some species of fishery in the Barents and Norwegian Seas. Analysis of two approaches developed by Russian and Norwegian specialists to estimate young fish allowable by-catches for different species of fishery, including those for shrimp one, and comparison of young fish allowable by-catches during shrimp fishery showed a priority of biological approach to a settling of this problem, reducing a risk of extreme withdrawal of young fish from ichthyocenosis by fishery. Expected economic damage because of withdrawal of young cod (*Gadus morhua*), haddock (*Melanogrammus aeglefinus*) and redfish (*Sebastes mentella*) during shrimp fishery is estimated at its catch different size. Based on this value the minimum size is estimated for shrimp, at which it will be profitable to use the values for young commercial fish allowable by-catches, suggested by the Russian approach. Expediency of further research on improving and approaching of biological and bioeconomic approaches to estimate allowable by-catches of young commercial fish species as one of fishery management measure is confirmed.

Soldal, A.V. and Løkkeborg, S. 1993. Seismisk aktivitet og fiskefangster : analyse av innsamlede fangsdata [Seismic exploration and fisheries catch rates : an analysis of collected data]. Fisken Havet 1993/4: 44 p.
[In Norwegian]

Catch data has been collected from commercial fishing vessels operating within areas where seismic exploration surveys with airguns have been conducted. The catch data were related to position of the seismic survey tracks and time of shooting. Catch data from three different cases has been analysed: The winter fisheries for cod (*Gadus morhua*) with longline off Finnmark, Northern Norway; bottom trawling for saithe (*Pollachius virens*) at Storegga, Central Norway; and shrimp (*Pandalus borealis*) trawling in the Barents Sea. In the longline fishery for cod, catch data from four different autoline vessels were collected. Catch rate reductions from 55 to 80% of cod on the longlines closest to the seismic survey tracks were observed. Catch reductions were observed at least 5 nautical miles from the seismic survey tracks. Catch records from six different bottom trawlers at Storegga showed a 33% reduction in saithe catches during shooting of short duration in April 1991. The catches continued to decrease for two days after the shooting. A corresponding analysis of catch data from the same area in June did not show any reduction in the saithe catches. The bycatch of cod increased threefold during the shooting in April, but returned to normal immediately after the shooting. Catch data from two shrimp trawlers in the Barents Sea were analysed. One of the vessels had a 60% increase in the shrimp catches when the shooting started, while there were no changes in the shrimp catch rates of the other vessel. No changes were found in the amount of bycatch of Greenland halibut (*Reinhardtius hippoglossoides*), while the bycatches of cod were significantly reduced (80-85%) on both vessels. It was concluded that seismic activity with airguns affects catch rates in these fisheries, but the nature and extent of the influence differs with kind of fishery, fish species and season. The confidence of the results from analyses of catch records from commercial fishing vessels is, however, somewhat confined because of the lack of control of the experimental design.

Solmundsson, J. 1993. Food and feeding habits of Greenland halibut (*Reinhardtius hippoglossoides*) in Icelandic waters. *In* Nordic Workshop on Predation Processes and Predation Models, Stykkisholmur (Iceland). Nordiske Seminar- og Arbejdsrapporter. 572. 79-92.

The stomach contents of Greenland halibut (*Reinhardtius hippoglossoides*), collected during May 1991 to March 1992 west, north and east of Iceland, were investigated. The main prey species were capelin, eelpouts and the shrimps *Hymenodora glacialis* and *Pandalus borealis*, capelin being the main prey species by weight and *H. glacialis* by number. Most of the animals found in stomachs were bathypelagic, planktonic or nektonic, indicating that Greenland halibut primarily searches for food in the water column. Crustaceans were the main food of the smallest Greenland halibut while the largest individuals mainly consumed relatively large fishes. The weight proportion of capelin was highest in Greenland halibut 20-30 cm, consequently decreasing with increased predator size. Some regional variation was found in food composition. The main differences lay in a larger proportion of large fishes in W- and E-areas, a larger proportion of capelin in NW- and NE-areas and a larger proportion of *H. glacialis* in N-area. Food composition also changed with depth. The proportion of capelin decreased while the proportion of other fishes increased with increasing depth.

Sonkodi, L. 1979. Annex to the worldwide fisheries marketing study : prospects to 1985: groundfish. Canada. Dept. of Fisheries and Oceans, Ottawa. 53 p.

Catches in deliberately "lost" gillnets were studied during a ten-day cruise conducted at Storegga 70 nm off the coast of mid-Norway in July 2000. Gillnet fleets were deployed at depths of between 537 and 677 m, and soak time varied from one to seven days. Four fleets set 45 days earlier were also retrieved during the cruise. Most of the catch (94 %) consisted of the target species Greenland halibut (*Reinhardtius hippoglossoides*). All individuals were categorized according to seven condition stages ranging from "alive with no injuries" to "only bones remaining". Results revealed that fish could be fully decomposed/consumed within a 24-hour period, probably due to amphipod and isopod scavenger activity. A decline in total catches was first observed after five days whereas catch composition remained stable during the first seven days. After 45 days a relatively high total catch was obtained but only 25 % were still at stages 1-4 (consumable). The cumulative catch after 45 days was estimated at 2.7 and 3.0 tons on the basis of two different methods. Gillnets retrieved after 45 days were evaluated as being highly effective, with gear saturation being the only factor leading to decreased efficiency.

Sonkodi, L. 1981. Annex to the worldwide fisheries marketing study : prospects to 1985: groundfish. Canada. Dept. of Fisheries and Oceans, Ottawa. 76 p.
[Revised]

Sorokin, V.P. 1980. Some features of the biology of the Greenland halibut, *Reinhardtius hippoglossoides* (Walbaum), in the Barents Sea. Can. Transl. Fish. Aquat. Sci. 4672: 35 p.
[Translated from Russian; Original appeared in: Materialy sessii uchonogo soveta PINRO po rezul'tatam issledovaniy v 1965 godu. (8): 44-67, 1967]

In order to augment knowledge about the life of the Greenland halibut, measures have been undertaken to collect additional information about the distribution and the size, age and sexual composition of the commercial catches, and tagging has also been introduced. Data are being gathered to determine the periods of formation of pre-spawning and spawning stocks, as well as the length of the spawning period. Histological specimens of gonads have been collected to study the sexual cycle, and to determine the type of spawning; these and other data are at the stage of laboratory processing. Furthermore, archive data on the occurrence of the Greenland halibut in the Barents Sea from 1959 to 1965 have been retrieved.

Sorokin, V.P. and Grigoryev, G.V. 1979. Spermatogenesis and the sexual cycle in the Greenland halibut of the Barents Sea population. Can. Transl. Fish. Aquat. Sci. 4541: 19 p.
[Translated from Russian; Original appeared in: Trudy PINRO. (23): 413-424, 1968]

The spermatogenesis and sexual cycle were studied in order to determine why the spawning period was so lengthy, to establish the nature of gametogenesis and the type of spawning, and to develop a maturity scale that is required for conducting large-scale field observations.

Stansbury, D.E. 1996. Conversion factors from comparative fishing trials for Engel 145 otter trawl on the FRV Gadus Atlantica and the Campelen 1800 shrimp trawl on the FRV Teleost. NAFO SCR documents 96/77: 15 p.

In 1995 DFO Science Branch, Newfoundland Region acquired a new research vessel the FRV Teleost. With the new vessel a new ground trawl, Campelen 1800 shrimp trawl rigged with rockhopper foot gear was introduced. To maintain continuity in the survey time series a comparative fishing experiment was conducted between the FRV Gadus Atlantica using the Engels 145 otter trawl with bobbin foot gear and the FRV Teleost. A total of 285 successful paired tows were conducted in the winter of 1995. Detail of the fishing trials are outlined in Warren (1996). An analysis between the two vessel/gear configurations gave conversion factors for five ground fish species. This paper illustrated the effect of the conversion from Gadus/Engels to Teleost/Campelen equivalents for Atlantic cod and Greenland halibut in NAFO Divs. 2J3K from 1978 to 1994.

Stene, A., Gundersen, A.C., Albert, O.T., Solemdal, P., and Nedreaas, K.H. 1998. Early development of Northeast Arctic Greenland halibut (*Reinhardtius hippoglossoides*). NAFO SCR documents 98/108: 8 p.

The early development of the Greenland halibut (*Reinhardtius hippoglossoides*) has never been described. This study contains some preliminary notes on the egg development of the Northeast Arctic Greenland halibut. Buoyancy and morphometric characteristics are compared with field sampled eggs, in order to identify these to species. The eggs in the ovary of ripening females were large (aout 4 mm), transparent, almost equal in size and stuck to the walls of the ovary. In ripe, artificially spawned females the ovulated eggs were all easily released in one batch. This may indicate that Greenland halibut has a comparatively long period between each egg batch delivered. Artificially spawned eggs of Greenland halibut were 3.3-4.2 mm and had neutral buoyancy in seawater of ca 33% during the first 4 days of development. During gastrulation the egg density increased until closure of blastopore. Eggs from field surveys had neutral buoyancy in seawater densities near 1.0279 g /cm super(3). This density is found at depths around 650 meters in the spawning area. The eggs hatched after nearly 2 months incubation. The embryo seems to hatch at an apparently premature stage.

Stene, A., Gundersen, A.C., Albert, O.T., Solemdal, P., and Nedreaas, K.H. 1998. Early development of Northeast Arctic Greenland halibut (*Reinhardtius hippoglossoides).* ICES CM 1998/O:27: 12 p.

The early development of the Greenland halibut (*Reinhardtius hippoglossoides*) has never been described in detail. This study contains some preliminary notes on the egg development of the Northeast Arctic Greenland halibut. Buoyancy and morphometric characteristics are compared with field sampled eggs, in order to identify these to species. The eggs in the ovary of ripening females were large (about 4 mm), transparent, almost equal in size and stuck to the walls of the ovary. In ripe, artificially spawned females the ovulated eggs were all easily released in one batch. This may indicate that Greenland halibut has a comparatively long period between each egg batch delivered. Artificially spawned eggs of the Greenland halibut were 3.3 - 4.2 mm and had neutral buoyancy in seawater of ca 33 ppt during the first four days of development. During gastrulation the egg density increased until closure of blastopore. Eggs from field surveys had neutral buoyancy in seawater densities near 1.0279 g/cm super(3). This density is found at depths around 650 meters (34.9 ppt S and 1.8 degree C) in the spawning area. The eggs hatched after nearly two months incubation. The embryo seems to hatch at an apparently premature stage.

Stene, A., Gundersen, A.C., Albert, O.T., Nedreaas, K.H., and Solemdal, P. 1999. Early development of Northeast Arctic Greenland halibut (*Reinhardtius hippoglossoides*). J. Northwest Atl. Fish. Sci. 25: 171-177.

The early development of the Greenland halibut (Reinhardtius hippoglossoides) has not been described. This study presents some preliminary notes on the egg development of the Northeast Arctic Greenland halibut. Buoyancy and morphometric characteristics of artificially spawned eggs are compared with field sampled eggs, in order to identify these to species. The eggs in the ovary of ripening females were large (about 4 mm), transparent, almost equal in size and stuck to the walls of the ovary. In running, artificially spawned females the ovulated eggs were all easily released in one batch. This may indicate that Greenland halibut has a comparatively long period between each egg batch delivered. Artificially spawned eggs of the Greenland halibut had a diameter varying from 3.3 to 4.2 mm and a neutral buoyancy in seawater of ca. 33[per mille sign] (c. 5[deg]C) during the first four days of development. During gastrulation the egg density increased until closure of blastopore. Eggs from field surveys had a diameter raging from 3.9 to 4.7 mm and a neutral buoyancy in seawater of 35.2[per mille sign] (ca. 5[deg]C). This corresponds to a density near 1.0279 g/cm3. This density is found at depths around 650 m (34.9[per mille sign] salinity and 1.8[deg]C) in the spawning area. The eggs hatched after nearly two months of incubation at ca. 2[deg]C. The embryo seemed to hatch at a premature stage.

Stensholt, B.K. and Nakken, O. 2001. Environmental factors, spatial density, and size distributions of 0-group fish. *In* Spatial processes and management of marine populations proceedings of the Symposium on Spatial Processes and Management of Marine Populations. *Edited by* . Kruse, G. H., Bez, N., Booth, A., Dorn, M. W., Hills, S., Lipcius, R. N., Pelletier, D., Roy, C., Smith, S. J., and Witherells, D. Alaska Sea Grant College Program report; AK-SG-01-02; Lowell Wakefield fisheries symposia series; 17: pp. 395-413.

Data from the August-September 1985-1998 joint Norwegian-Russian annual 0-group survey in the Barents Sea and adjacent waters 1985-1998 are used to describe and discuss the spatial density and size distributions of 0-group fish in relation to temperature, salinity, and daylight. The eight species of 0-group fish studied are cod, haddock, saithe, herring, redfish, capelin, polar cod, and Greenland halibut. The ambient temperature and salinity are calculated separately for each species in the Barents Sea and the Svalbard waters as well as the total area. The interannual variations of ambient temperatures are found to be greater than the corresponding variations of mean temperature at fixed stations along the Kola section, commonly used as the area's temperature index. This finding calls for caution when observations at fixed locations and depths are used to characterize variations in the environment of the organisms. Observed differences in mean length within and between years for each species are compared with the associated variations in ambient temperature and salinity. Polar front and thermocline form natural boundaries for the 0-group spatial density distribution, but the vertical density distribution of the 0-group may change with day and night. In all 5 years considered, the daytime vertical distribution of 0-group cod is about 10 m deeper, with significant differences in 3 out of 5 years.

Stenson, G.B., Ni, I.H., Ross, S.A., and McKinnon, D. 1991. Hooded seal, *Cystophora cristata*, feeding and interactions with commercial fisheries in Newfoundland. CAFSAC Res. Doc. 91/45: 16 p.

Concern over the potential impact of hooded seals (*Cystophora cristata)* on commercial fisheries has increased in recent years. The primary reasons for this are the assumed increase in abundance since the end of the large-vessel hunt in 1983 and the perception that seals eat a substantial amount of commercially important fish daily. This paper reviews existing knowledge of hooded seal diets, presents the results of the first quantitative examination of hooded seal stomachs in the Newfoundland area, and indicates areas where interaction between hooded seals and commercial fisheries may occur. Between 1982 and 1990, 201 hooded seal stomachs were collected by DFO research personnel or through a shore-based collector program involving sealers and fishermen. Species composition of diet was reconstructed by examining stomach contents and identifying remains recovered using a sieve-water bath technique. Of 89 stomachs containing food, the most frequently occurring species were Greenland halibut (53.9%), Arctic cod (27.0%), capelin (23.6%), squid (19.1%), herring (13.5%) and redfish (11.2%). Unidentified fish were found in 9.0% of the stomachs examined. Of these important prey species, Greenland halibut, capelin, herring and redfish are also commercially harvested by Canadian fisheries. Due to lack of knowledge concerning hooded seal distribution in relation to prey species and food requirements, the extent of possible interactions with commercial fisheries cannot be estimated.

Stephenson, T.D., Treble, M.A., Mathias, J.A., and Pike, D.G. 1997. Experimental tagging of Greenland halibut *(Reinhardtius hippoglossoides*) in Cumberland Sound, Baffin Island, during the winter fishery, May 1997. NAFO SCR documents 97/48: 7 p.

Several attempts have been made to tag Greenland halibut (*Reinhardtius hippoglossoides*) in Cumberland Sound to determine whether adult fish move into Davis Strait. An experiment was conducted in May 1997 to test the feasibility of tagging during the winter using longlines. Sub-zero air temperatures appeared to be the main factor limiting fish survival. A method was developed of reducing the fish's exposure to ambient air conditions. Tagged fish were held in a specifically-designed cage at depths below the cold surface water (deeper than 200m), to assess post tagging survival. Repeated trials indicated no more than 10% mortality, even when fish were held for 56.5 hours, demonstrating that it is possible to successfully tag and release Greenland halibut during the winter using longlines set through the ice. Further modifications to the basic method should be adequate to enable efficient and cost-effective tagging of a large number of fish without significant mortality.

Storr-Paulsen, M. and Jørgensen, O.A. 2003. Biomass and abundance of demersal fish stocks off West Greenland estimated from the Greenland shrimp survey, 1988-2002. NAFO SCR documents 03/29: 24 p.

The Greenland Institute of Natural Resources has conducted an annual bottom trawl survey off West Greenland since 1988. The main purpose of the survey is to evaluate the biomass and abundance of Northern shrimp (*Pandalus borealis),* but data on most fish species has been recorded. This paper presents biomass and abundance estimates together with length frequencies of cod (*Gadus morhua*), redfish (*Sebastes*), wolfishes (*Anarhichas*) ,American plaice (*Hippoglossoides platessoides*) and starry skate from the 2002 survey. A recruitment index for Greenland halibut is presented as well.

Storr-Paulsen, M. and Jørgensen, O.A. 2004. Biomass and abundance of demersal fish stocks off West Greenland estimated from the Greenland shrimp survey, 1988-2003. NAFO SCR documents 04/18: 28 p.

Since 1988 Greenland Institute of Natural Resources annually has conducted a bottom trawl survey off West Greenland. The main purpose of the survey is to evaluate the biomass and abundance of northern shrimp (*Pandalus borealis*), but data on most fish species have been recorded. This paper presents biomass and abundance estimates together with length frequencies of cod (*Gadus morhua*), Greenland halibut (*Reinhardtius hippoglossoides*), redfish (*Sebastes* spp.), wolffishes (*Anarhichus* spp.), American plaice (*Hippoglossoides platessoides*) and starry skate (*Raja radiata*) from the 2003 survey. Further, a recruitment index for Greenland halibut is presented.

Storr-Paulsen, M. and Jørgensen, O.A. 2005. Biomass and abundance of demersal fish stocks off West Greenland estimated from the Greenland shrimp survey, 1988-2004. NAFO SCR documents 05/39: 27 p.

Since 1988 Greenland Institute of Natural Resources has annually conducted a bottom trawl survey off West Greenland. The main purpose of the survey is to evaluate the biomass and abundance of Northern shrimp (*Pandalus borealis*), but data on fish species have been recorded since 1992. This paper presents biomass and abundance estimates together with length frequencies of cod, Greenland halibut, redfish, wolffishes, American plaice and starry skate from the 1992-2004 surveys. Further, a recruitment index for Greenland halibut is presented.

Strogonov, A.A., Samchik, L.V., Jones, A.C., and Villegas, L. 1979. Dynamics of commercial accumulations of deep-sea fish in the Labrador Sea. Oceanol. Acad. Sci. USSR. 19: 594-602.

A qualitative model is examined for the relation of the distribution and structure of accumulations of 2 commercial fish species, the pelagic rat-tail (*Macrourus*) and the bottom halibut (*Reinhardtius hippoglossoides*), to the surface wind (pressure field), surface temperature, and the deep scattering layer (DSL) in the Labrador Sea. The characteristics of the size-sex and density structure of rat-tail and halibut accumulations, their mode of formation, migration, and restructuring under the effect of currents are described.

Suzuki, N., Nishida, M., and Amaoka, K. 2001. The phylogenetic position of the genus *Atheresthes* (Pleuronectidae) and its classification: a molecular phylogenetic approach using mitochondrial sequence data. Bull. Fish. Sci. Hokkaido Univ. 52: 39-46.

The phylogenetic position of the genus *Atheresthes*, long thought to be closely related to *Reinhardtius* and included the latter by a recent study, was examined from sequence data of the mitochondrial cytochrome b coding region. The nucleotide sequences of 1,140 bp were determined and compared for 11 species, including two outgroup taxa. A total of 464 sites (40.7%) were variable among the species. The pairwise nucleotide differences among ingroup species ranged from 7.5% to 20.8%, those between *A. evermanni* and the other pleuronectids examined being extremely high (19.1-20.8%) and similar to the values between an outgroup species (*Paralichthys olivaceus*) and all pleuronectids examined (18.4-20.4%). Phylogenetic analyses by maximum-parsimony (MP) and maximum-likelihood (ML) methods showed that the pleuronectids did not form a single monophyletic group, at the same time supporting the monophyly of all of the latter except *A. evermanni*, with high confidence levels (94% and 91%, respectively). The unrooted MP tree resulted in a branch length to *A. evermanni* much longer than those among other ingroup species, the results overall indicating that *A. evermanni* was not closely related to *Reinhardtius hippoglossoides* and was best placed in a basal position in pleuronectid phylogeny. This supports retention of the above two genera.

Swain, D.P. and Benoit, H.P. 2001. Geographic distribution of selected marine fish in September in the southern Gulf of St. Lawrence based on annual bottom-trawl surveys = Distribution geographique de certaines espèces de poissons marins dans les relevés annuels au chalut de fond pour le sud du Golfe du Saint-Laurent. Canadian Science Advisory Secretariat research document 2001/118: 68 p.
[In French and English]

Exploration for oil and gas has been proposed for the southern Gulf of St. Lawrence between Prince Edward Island and Cape Breton Island. This paper provides background information on the geographic distribution of selected marine fish species in the southern Gulf of St. Lawrence to aid in the determination of potential impacts of the proposed exploration. Distributions are based on catches in bottom-trawl surveys conducted each September since 1971. It should be noted, however, that many of these species undertake extensive seasonal migrations. The distributions presented here may be representative of the summer and early fall feeding season but will not reflect the distributions of most species at other times of the year.

Swartzman, G., Huang, C., and Kaluzny, S. 1992. Spatial analysis of Bering Sea groundfish survey data using generalized additive models. Can. J. Fish. Aquat. Sci. 49: 1366-1378.

Generalized additive models (GAM) are herein applied to trawl survey data in the eastern Bering Sea with an eye to (1) detecting trends in groundfish distributions and (2) improving abundance estimates by including the trend. GAM is a statistical method, analogous to regression, but without the assumptions of normality or linearity that relate a response variable (in this case, fish abundance) to location (latitude and longitude) and associated environmental variables (e.g. depth and bottom temperature). GAM provided reasonable (i.e high r2) fits to the spatial distribution of five flatfish species *[Pleuronectes asper, P. bilineatus, Reinhardtius hippoglossoides, Hippoglossoides elassodon, P. quadrituberculatus*], and was able to define a spatial "signature" for each species, namely their preferred depth and temperature range. GAM also gve lower average abundance and abundance variability estimates for these five flatfish species than the stratified sampling procedure previously employed.

Talbot, A. 1993. Evolution de la pêche sportive hivernale du flétan du Groenland (*Reinhardtius hippoglossoides*) et de la morue franche (*Gadus morhua*) dans le fjord du Saguenay:

rapport final. Universite du Québec a Chicoutimi, Groupe de recherche en productivite aquatique, Chicoutimi, Québec. 84 p.
[In French]

Les objectifs de cette etude sont: d'approfondir les conclusions obtenues lors de la premiere phase du travail et publiees dans le document "Description de la pêche sportive hivernale dans le fjord du Saguenay et de ses effets potentiels sur la ressource", de developper et de verifier certaines hypotheses sur la structure des populations et d'identifier les parametres de l'exploitation qui requiert une intervention au niveau de la recherche ou de la gestion. L'effort d'echantillonnage a porte essentiellement sur le flétan du Groenland a Sainte-Rose-du-Nord. La description de certaines caracteristiques du cycle de vie represente donc l'element le plus important de ce rapport. Les donnees sur la morue franche n'ont ete ajoutees qu'en guise d'information complementaire au rapport precedent et ne font pas l'objet d'une analyse aussi detaillee que celle appliquee au flétan du Groenland qui fera l'objet d'une publication scientifique. Les résultats et conclusions de cette section doivent etre interpretes dans le contexte du projet global.

Taning, A.V. 1936. On the eggs and young stages of the halibut. Meddelelser fra Kommissionen for Danmarks fiskeri-og havundersogeiser. Serie, fiskeri 10: 23 p.

Contents: 1) Eggs of halibut; 2) Pelagic postlarval stages - a) Additional notes of description of the pelagic stages, b) Distribution of the pelagic stages; 3) The smallest bottom-stages of the O-group; 4) Spawning season; 5) Spawning area and hydrographical conditions there; 6) on the occurrence of postlarval stages of the Greenland halibut, *Reinhardtius hippoglossoides* in the Denmark Strait.

Templeman, W. 1970. Additional tabular data related to the paper: vertebral and other meristic characteristics of Greenland halibut, *Reinhardtius hippoglossoides*, from the northwest Atlantic (Templeton, 1970). Can. Tech. Rep. Fish. Aquat. Sci. 192.

Templeman, W. 1970. Vertebral and other meristic characteristics of Greenland halibut, *Reinhardtius hippoglossoides*, from the northwest Atlantic. J. Fish. Res. Board Can. 27: 1549-1562.

Vertebral averages were not useful in separating Greenland halibut stocks of the northwest Atlantic, apart from the possible separation of the Gulf of St. Lawrence population. Mean numbers of vertebrae did not differ siginificantly at the 5% level within the main areas in samples collected between 1950 and 1968 form Baffin Bay to the southern Grand Bank. Mean numbers of vertebrae for each of these main areas also were, with one exception, not significantly different. Mean vertebral numbers of Greenland halibut from the norhtern Gulf of St. Lawrence (61.850 ± 0.057 SE) differed *(P* < 0.001) from the overall mean for the remainder of the northwest Atlantic (61.575 ± 0.014). The similar means were associated with similar temperatures at depths of 800 m and over, where eggs and early larvae are presumed to develop. Means of vertebral numbers of males and females were not significantly different. Precaudal and caudal vertebral numbers were negatively correlated. Fused vertebrae were not numerous and did not show much localization except toward the posterior end of the vertebral column, especially in the two most posterior whole vertebrae. The numerical value of each fused partial vertebra was very close to one. Anal and dorsal fin-ray numbers were highly correlated but were not correlated significantly with vertebral numbers. The means of dorsal and anal fin-ray numbers in a few samples from west Greenland to the southern Grand Bank wre not significantly different.

Templeman, W. 1973. Distribution and abundance of the Greenland halibut *Reinhardtius hippoglossoides* in the northwest Atlantic. Int. Comm. Northwest Atl.Fish. Res. Bull. 10: 83-98.

The author provides information on research catches of Greenland halibut, *R. hippoglossoides*, in the Northwest Atlantic in relation to area, depth, and temperature, and also deal with commercial landings of Greenland halibut from this area. Greenland halibut are most plentiful in northern areas from the Northeast Newfoundland Shelf and the deep cold bays off the east coast of Newfoundland to off Baffin Island and to West Greenland, where temps ranging from -1 degree, or more usually -0.5 degrees, to 3 degrees C occur more deeply over large areas than farther south or at the continental slope. Farther southward, where such cold water is less abundant and shallower, Greenland halibut are commercially scarce. Essential also is a neighbouring deepwater spawning area with slightly higher temperatures, where Greenland halibut may be plentiful, especially at spawning season. Young fish are abundant where currents take the gradually descending fry from the spawning ground into moderately deep and moderately cold water. The largest commercial landings from the North-west Atlantic in recent yrs were from ICNAF Division 3K, possessing a broad shelf with deep water colder than in the same depths at the continental slope. Smaller Greenland halibut are shallower and the depth range of Greenland halibut extends from usually more than 90 m to 1,460-1,600 m. They were not found at 1,810-2,360 m. Good commercial catches are often taken between 300 and 900-1,100 m. Peak landings of 40,000 metric tons of Greenland halibut were taken in the Northwest Atlantic in 1969. Landings decreased to 29,000 metric tons in 1971. Great catch decreases occurred rapidly in a bottom gillnet fishery for Greenland halibut in Trinity Bay, Newfoundland.

Tok, K.S. and Biryukov, I.A. 1998. Distribution and some features of the biology of *Reinhardtius hippoglossoides matsuurae* (Pleuronectidae) and *Sebastolobus macrochir* (Scorpaenidae) from the eastern coast of Sakhalin. J .Ichthyol. 38: 143-146.

Currently, intensive fishery has been developed on the continental slope of the seas of the Far East. Among the species fished, *Reinhardtius hippoglossoides matsuurae* and *Sebastolobus macrochir* are of certain interest, because their biology has been studied insufficiently, especially in Kuril and Sakhalin waters. This work was aimed at the study of the distribution, size composition, and duration of the spawning season of *Reinhardtius hippoglossoides matsuurae* and *Sebastolobus macrochir* in the depth dropping near the eastern coast of Sakhalin.

Topolniski, D.E. 1993. Financial and economic analysis of the 1986-1990 exploratory fisheries for turbot and scallops in Cumberland Sound, Baffin Island. Economic and commercial analysis report 135. 68 p.

Financial and economic models are prepared for exploratory fisheries in Cumberland Sound, Baffin Island for turbot and Iceland scallops. The analysis suggests a limited potential for fish harvesting and processing operations to provide normal returns to labour and capital in the absence of ongoing government support. Social impacts accrue in terms of employment activity, supplements to cash incomes and to subsistence activity, and reported improvements in individual and community morale.

Torres, P., Rodriguez-Marin, E., and Loureiro, I. 2000. Preliminary results from feeding analysis for the most abundant demersal fishes in Flemish Cap during summer (1993-2000). NAFO SCR documents 00/60: 9 p.

The food and feeding of 15 fish species taken by demersal trawl from Flemish Cap Bank in summer (1993-2000) are described using 35,645 stomachs. In general the feeding intensity was high in all the species with a maximum value for *Gadus morhua* (96.8%) and a minimum for *Lycodes reticulatus* (51.5%). The prey spectrum was wide with a total of 175 items for all the stomachs analysed. In frequency of occurrence the crustaceans make up the most important prey group (F.O. - 71.4%), while in volume (V = 38.2%) they are less significant than fish (V = 41.4%). The main prey taxa in frequency of occurrence were *Hyperiidea, Pisces, Ophiuroidea, Pandalus borealis* and *Chaetognata*. Three categories, relating with diet breadth, were made: specialists, low diversity feeders and high diversity feeders,

Treble, M.A. 1999. Exploratory fishery results for Greenland halibut (*Reinhardtius hippoglossoides*) in NAFO Division 0A, 1996-98. NAFO SCR documents 99/45: 11 p.

An exploratory fishery for Greenland halibut (*Reinhardtius hippoglossoides*) began in NAFO Division 0A in 1996 with an initial harvest of 329 t. This fishery has continued with harvests of 241 t in 1997 and 42 t in 1998. Catch values are all based on observer estimates. Restrictions were placed on the fishing effort during the first two years in an attempt to determine stock distribution. In 1998, 27 sentinel locations were selected and standardized tow protocols established. Catch rates at these locations will be tracked over time to assist in the assessment of the fishery. Catch rates were lower in 1997 (340 kg/h) than in 1996 (667 kg/h). This may be due to inexperience at fishing for Greenland halibut by the captain and crews in 1997. The length and age ranges are similar for all years. There were two modes in the 1996 length frequency distribution compared to a single mode in 1997 and 1998. The age distribution is considerably older than that previously reported for Greenland halibut in SA0+1. Investigations are being conducted in an effort to validate these ages.

Treble, M.A. 2002. Analysis of data from the 2001 trawl survey in NAFO Subarea 0. NAFO SCR documents 02/47: 28 p.

Two stratified random otter trawl surveys covering depths of 400 m to 1500 m and targeting Greenland halibut (*Reinhardtius hippoglossoides*) were conducted in NAFO Subarea 0, Division 0A from September 16 to 23 and Division 0B from October 19 to 26, 2001. This was a collaborative effort between Fisheries and Oceans Canada, the Nunavut Wildlife Management Board, and the Greenland Institute of Natural Resources. Survey coverage was the same as in previous years (1 set per 750 km super(2) for Div. 0A and 1 set per 1030 km super(2) for Div. 0B) with a minimum of two tows per stratum. However, both trips experienced difficulties in completing the survey in the time available and some strata were missed. In Div. 0A 48 of 92 tows were completed while in Div. 0B 36 of 76 tows were completed. Greenland halibut were present in all tows with the greatest densities at 751-1000 m in Div. 0A and at 1001-1250 m in Div 0B. Total estimated biomass and abundance in the Div. 0A survey area were 97,627 tons and 142.7x10 super(6), respectively. Estimated biomass and abundance in the Div. 0B survey area were 68,917 tons and 85.9x10 super(6) fish. Lengths ranged from 10 cm to 99 cm for Div. 0A with 68.1% less than 45 cm. For Div. 0B lengths ranged from 8 cm to 97 cm with 46.8% less than 45 cm. The distributions both had a single mode, 43 cm for Div. 0A and 45 cm for Div. 0B. The age length key from the Greenland survey in Div. 1A to D was used to determine age distribution of the population in SA0. Ages for males and females combined ranged from 0 to 19 years in Div. 0A and 0 to 18 years in Div. 0B. The 1996 year-class was most abundant in Div. 0A and the 1995 year class was most abundant in Div. 0B in 2001. The catch of other commercially important species was minimal. However, some data on these and other non-commercial species are also presented.

Treble, M.A. 2003. Results of a Greenland halibut (*Reinhardtius hippoglossoides*) tagging project in Cumberland Sound, NAFO Division 0B, 1997-2000. NAFO SCR documents 03/41: 7 p.

Cumberland Sound supports a small inshore fishery for Greenland halibut. It has been hypothesized that fish that settle within Cumberland Sound do not migrate back to offshore waters. Extensive tagging experiments in Greenland throughout the late 1980s and 1990s have shown that Greenland halibut that settle in the fiords of Northwest Greenland do not migrate back to spawning areas in the southern Davis Strait and therefore do not contribute to the overall reproduction of the population. During an exploratory fishery in 1994, 407 Greenland halibut were tagged near the mouth of Cumberland Sound. Since then three fish have been recaptured, two in the offshore Division 0B and one on the winter fishing ground in Cumberland Sound. In 1997 an attempt to tag Greenland halibut in the winter was successful and a four-year winter tagging project was initiated in Cumberland Sound. A total of 1,674 fish were tagged during this period and 13 have been recaptured, none in the offshore area. There is some evidence to suggest that there is a portion of Cumberland Sound near the mouth where there are migratory forms present and from which they move either out to Davis Strait or deeper within Cumberland Sound. There is also evidence to suggest that there are non-migratory forms in the vicinity of the winter fishing grounds within Cumberland Sound.

Treble, M.A. 2004. Summary of data from the offshore Canadian commercial fishery for Greenland halibut in subarea 0. NAFO SCR documents 04/44: 8 p.

This document updates information from the commercial fishery for Greenland halibut (*Reinhardtius hippoglossoides)* in Subarea 0. The otter trawl fisheries during 2003 in Div. 0A and 0B, as well as the longline fisheries in 0A, were well sampled with respect to length compositions. In Div., 0A, length samples were collected from the Norwegian vessels fishing Canadian quotas under charter arrangements. In Div. 0A and 0B, length data were collected from Canadian-flagged vessels as well, although there were no length or otolith samples from the fixed gear (longline, gillnet) fisheries in Div. 0B in 2003.

Treble, M.A. 2005. Analysis of the data from the 2004 trawl surveys in NAFO Division OA. NAFO SCR documents 05/56: 23 p.

Two stratified random otter trawl surveys covering depths of 400 m to 1500 m and targeting Greenland halibut (*Reinhardtius hippoglossoides*) were conducted in NAFO Division 0A (Baffin Bay). The first was conducted in northern Div. 0A from September 4 to 12 in an area that had not been previously surveyed. The second, from October 14 to 24, 2004 covered previously surveyed strata in southern Div. 0A. In northern Div. 0A there were 43 valid tows in a survey area covering 54 204 sq km. In southern Div. 0A 58 stations were successfully completed and the survey area was 44 484 sq km. Greenland halibut were distributed throughout the surveyed area and were present in all but one tow taken at 340 m in northern Div. 0A. This was the only haul that we were able to complete in depths <500 m during the northern survey. Biomass and abundance in northern Div 0A was estimated to be 45,877 tons (S.E. 9,406) and 4.85 x 107 (S.E. 9.0 x 106), respectively. Densities declined with depth from 0.97 t/sq km to 0.5 t/sq km. The estimate of biomass 0A was 86,176 (S.E. 12 502) with abundance of 1.11 x 108 (S.E. 1.7 x 107). Densities were highest (2.0 to 3.3 t/sq km) within the 751 to 1 000 m depth strata. Overall strata, mean densities were lower in northern Div. 0A (0.8 t/sq km) than in southern Div. 0A (1.9 t/sq km). While the overall abundance in southern Div. 0A is relatively unchanged from previous surveys a decline in abundance/sq. km was observed for the 1 001-1 250m depths from a high of 4 579 per sq. km to 3 319 per sq km. The overall length distribution for southern Div. 0A in 2004 ranged from 12 cm to 96 cm with a mode of 45 cm and 57% were less than 45 cm. The distribution for northern Div. 0A ranged from 12 cm to 81 cm with two modes, one at 33 and a larger one at 48 cm. Age distribution was estimated for northern Div. 0A using an age length key from a small (n = 80) subset of samples from three different age structures. Scale ages using a polarized transmitted light source ranged from 1 to 31 years with multiple modes, a small one at 10 years, followed by a larger one at 16 years. Otolith section ages ranged from 1 to 23 years with a mode at age 11. Whole left otolith ages ranged from 1 to 20 years with a mode at age 12.

Treble, M.A. and Bowering, R. 2002. The Greenland halibut (*Reinhardtius hippoglossoides*) fishery in NAFO Division 0A. NAFO SCR documents 02/46: 10 p.

In 1996, 1997 and 1998 exploratory licenses were issued for a relatively small (approx. 300 tons) offshore otter trawl fishery directed for Greenland halibut (*Reinhardtius hippoglossoides*) in NAFO Div. 0A. The fishery expanded to five vessels in 2001 with a TAC of 4,000 tons for Div. 0A and 1A (offshore). These vessels harvested 2,625 tons between 4 September and 30 November 2001. Two of the class 7 vessels used both the single trawl and double trawl gear configurations. The paper presents catch, effort and length data for the fisheries from 1996 to 2001. Effort has been primarily concentrated approximately 200 m on either side of the 1000 m depth contour. The mean catch rate for a single trawl (non-standardized) has varied from 336 to 641 kg/h. The mean catch rate for the twin trawls was 862 kg/h in 2000 and 882 kg/h in 2001. In 1996 lengths ranged from 20 cm to 95 cm with two distinct modes, one at 41 cm and another at 50 cm (Fig. 4). In subsequent years there has been a narrowing of the distribution and a shift to a single mode, 50 cm in 1997, 47 cm in 1999 and 44 cm in 2001. The proportion of fish in the catch that are below 45 cm in length is unusually high. It is important to determine the relationship between fish in Baffin Bay with those areas to the south as well as the inshore.

Treble, M.A. and Jørgensen, O.A. 2002. Summary of results for Greenland halibut from trawl surveys conducted in NAFO Subareas 0 and 1 from 61 degree N to 74 degree N in 2001. NAFO SCR documents 02/60: 8 p.

In 2001, surveys of Greenland halibut (*Reinhardtius hippoglossoides*) were conducted in Subarea 0 by Canada and in Subarea 1 by Greenland. This is the first time that surveys have been conducted so extensively in a single season within Davis Strait and Baffin Bay (up to 74 degree N). Results are presented for each of these areas in separate NAFO Scientific Council Research Documents (SCR Doc. 02/30, 02/47). This paper presents a summary of the data over the entire Greenland halibut stock area Subareas 0+1. The densities and abundances km super(-2) were almost alike at comparable depths and areas and the total biomass and abundance was almost identical in the two areas. The length distribution in Div. 1CD and 0B was almost totally overlapping with modes at 45 cm. A single mode at 43 cm was seen in Div. 0A, while several modes were seen in the length distribution from Div. 1 including modes at 8, 15 and 25 cm primarily constituted of fish coming from shallow waters <400 m not covered in the other areas.

Treble, M.A., Brodie, W.B., Bowering, W.R., and Jørgensen, O.A. 2000. Analysis of data from a trawl survey in NAFO Division 0A, 1999. NAFO SCR documents 00/31: 19 p.

A stratified random otter trawl survey covering depths of 400 m to 1500 m and targeting Greenland halibut (*Reinhardtius hippoglossoides*) was conducted in NAFO Division 0A from October 7 to 19, 1999. This was the first deepwater trawl survey within the Canadian waters of Baffin Bay and was a collaborative effort between Fisheries and Oceans Canada, the Nunavut Wildlife Management Board, the Qukiqtaaluk Wildlife Board and the Greenland Institute of Natural Resources (GINR). Survey coverage was 1 set per 750 km super(2) with a minimum of two tows per stratum. This criteria was met in all but four strata with 66 of 90 planned tows conducted. Greenland halibut were present in all tows with the highest densities between 1001 m and 1250 m. total estimated biomass and abundance for the survey area were 83,340 tons and 141 x 10 super(6), respectively. Lengths ranged from 6.5 cm to 94.5 cm with 71.5% less than 42.5 cm. The modal length was 38.5 cm. Age distribution was estimated using an age-length key from the GINR 1999 survey of NAFO Divisions 1CD. Ages ranged from two to 15 years with a modal age of four years. The majority (96.1%) were less than eight years old. The catch of other commercially important species was minimal. However, data on these and other non-commercial species from the by-catch are also presented.

Treble, M.A., Brodie, W.B., Bowering, W.R., and Jørgensen, O.A. 2001. Analysis of data from a trawl survey in NAFO Division 0B, 2000. NAFO SCR documents 01/42: 19 p.

A stratified random otter trawl survey covering depths of 400 m to 1500 m and targeting Greenland halibut (*Reinhardtius hippoglossoides*) was conducted in NAFO Division 0B from October 9 to 19, 2000. This survey was a collaborative effort between Fisheries and Oceans Canada, the Nunavut Wildlife Management Board, and the Greenland Institute of Natural Resources. Survey coverage was 1 set per 1030 km super(2) with a minimum of two tows per stratum. This criteria was met in all strata with 64 valid tows of the 69 tows conducted. Greenland halibut were present in all tows with the greatest densities between 501 m and 1250 m. Total estimated biomass and abundance for the survey area were 56,212 tons and 74.6 x 10 super(6), respectively. Lengths ranged from 7 cm to 92 cm with 56.5% less than 46 cm. The distribution was bi-modal with peaks at 19 cm and 43-45 cm. Age distribution was estimated using an age-length key from the GINR 2000 survey of NAFO Divisions 1CD. Ages ranged from 0+ to 19 years with a modal age of five years. The majority (90.6%) were less than eight years old. The catch of other commercially important species was minimal. However, data on these and other non-commercial species from the by-catch are also presented

Treble, M., Cosens, S., and Parmiter-Richards, D. 2002. Canadian research report for 2001 : Part I. Central and Arctic Region, Part II. Newfoundland Region. NAFO SCS documents 02/10: 24 p.

Treble, M., Cosens, S., and Richards, D. 2003. Canadian research report for 2002. Part A, Central and Arctic Region. Part B., Newfoundland Region. NAFO SCS document 03/10: 25 p.

Treble, M.A., Brodie, W.B., and Power, D. 2003. Summary of data from the offshore Canadian commercial fishery for Greenland halibut in subarea 0. NAFO SCR documents 03/50: 18 p.

This document updates information from the commercial fishery for Greenland halibut in Subarea 0 with a focus on the Canadian commercial fishery in 2002. There is a description of the fishery catch trends and sampling data, including comments on mesh and hook size regulations and processed to whole weight conversion factors used in the Div. 0A fishery. Catches in the Div. 0A otter trawl fishery were almost equally divided between males and females while females were more common in the Div. 0A and Div. 0B long line catches. In 2002 the long line fishery in Div. 0A had 21.3% of fish less than 46 cm, similar to the 20.7% in the Div. 0B otter trawl catch with both much lower than the 38.3% found in the Div. 0A fishery. Catch at age showed a slight shift toward younger fish after 1993, with a peak at age 7 in each year since then. As in previous years, length frequency distributions and catch at age from 2002 indicate larger fish in the fixed gear catches compared to the mobile gears. There were no major trends in weight at age during the period 1990 to 2002. Due to the frequency of fleet changes in this fishery, and the lack of continuity among vessels within fleets, a standardized index of CPUE for Subarea 0 alone is not considered to be a reliable indicator of overall stock abundance. CPUE data for 2000 and 2001 are incomplete and not updated here. Twin trawls were present in the Greenland halibut fishery in Subarea 0 beginning in 2000 but complete data were not available from this fleet component.

Treble, M.A., Campana, S.E., Wastle, R.J., Jones, C.M., and Boje, J. 2005. An assessment of the age determination methods, with age validation of Greenland halibut from the Northwest Atlantic. NAFO SCR documents 05/43: 22 p.

Concern with the accuracy and precision of the current Greenland halibut (*Reinhartius hippoglossoides)* age determination method prompted us to examine two age validation methods, chemical marking with oxytetracycline (OTC) and bomb radiocarbon dating (14C released during atmospheric testing of nuclear bombs in the 1960s). In addition we analyzed growth of tag-recaptured fish and the precision of three age determination methods, left whole otoliths, otolith sections and scales (polarized transmitted light method). Our growth model for tag-recaptured data suggests a growth rate of approximately 2-3 cm/yr for fish in the size range of 55-70 cm. Age bias plots comparing the age interpretations among structures showed that whole otolith age and otolith section age tended to be similar across all ages. However, both otolith preparations underestimated scale ages in older fish, particularly after age 15. Repeated age readings indicated that ageing precision was somewhat lower for the otolith-based methods (coefficient of variation of 8.4% and 11.1% for whole otoliths and otolith sections, respectively) than for the scale ages (5.2%). Three OTC marked otoliths were examined. One of these, a 66 cm female that had been at-large for 3 years, 10 months had an annual growth rate of approximately 1.5 cm/yr. The OTC mark was visible at the edge on the whole otolith but we could not determine what should have been3 annuli within the new growth area. We were able to make out what we presumed to be three annuli on the otolith cross-section. However, in some areas of the section it was not as distinct as in others and the subsequent interpretation of annuli prior to the mark was difficult. The 14C based age values of mature otoliths indicate that the ages for all but one of these samples were beyond the age determined by either the whole otolith method or the otolith section (the maximum observed age from whole and section ages was 20 years and from 14C it was 27 years). While the section ages were somewhat closer to the minimum age determined by the 14C we were not always able to match the assumed true age based on the 14C. Comparable scale ages were not available.

Tremblay, C. 1982. Le flétan du Groenland du golfe du Saint-Laurent (4RST) : conséquences de son exploitation et évaluation de son recrutement [Greenland halibut in the Gulf of St. Lawrence (4RST) : results of exploitation and evaluation of recruitment]. ICNAF Res. Doc. 82/18: 32 p.
[In French]

The landings of the Greenland halibut reached in 1979 a maximum of 9,129 T then dropped to 7,012 T in 1980 (a decrease of 24%) and to 2,920 T in 1981 (a decrease of 58%). Since 1978 the fishing pattern has been the same, 64% of nominal catch from 4T, 79.5% of the landings have come from Quebec. It was shown by a cruise in 1981 that the Greenland halibut concentrates in the St. Lawrence estuary in summer. This probably accounts for the high catch in 1978, 1979, and 1980 by the Quebec inshore fisherman. The data show that the same year-classes were fished in 1981, 1982 and 1983 (3, 4 and 5 yr old individuals). The data show too the presence of a large number of prerecruits (2 yr olds) which will enter the fishery in 1984-85 when they are 5 or 6 yrs old.

Tremblay, C. 1983. Quelques données sur le flétan du Groenland de 4RST [Data on the 4RST Greenland halibut]. CAFSAC Res. Doc. 83/57: 15 p.
[In French]

Catches of Greenland halibut reached a maximum of 9,219 t in 1979 and then experienced sizable decreases, stabilizing at about 2,500 t for 1981 and 1982. This situation is confirmed by the CPUE of shrimpers, which dropped from 23 kg/h in 1979 and stabilized at 5.0 kg/h for 1981-82. Commercial fishing has been conducted for the last few years on the same 1972-73-74 and 75 year classes. The 1976-77 and 78 year classes, which form the larger part of the exploitable biomass for 1983-84, show a relatively low level of abundance. On the other hand, the 1979-80 year class, which will constitute the next recruitment, show a relatively high level of abundance.

Tremblay, C. and Axelsen, F. 1980. Données sur la pêche, la biologie et l'abondance du flétan du Groenland (*Reinhardtius hippoglossoides*) dans le Golfe du Saint-Laurent [Data on the fishery, biology and abundance of Greenland halibut (*Reinhardtius hippoglossoides)* in the Gulf of St. Lawrence]. CAFSAC Res. Doc. 80/34: 27 p.

[In French]

Since 1975, catches have increased from 1544 t to 9219 t in 1979. The landings come mainly from Division 4S (65%), and are made largely by Quebec (70%). Originally, most of the landings consisted of bycatches from shrimpers, but since 1978, a gillet fishery aimed at this species has been developing in Quebec. The size and age structure of the population is fairly stable. The bulk of the male population range between 40 and 58 cm (6 to 9 yr of age), while the females range between 43 and 64 cm (6 to 10 yr of age). In general, the females live to a greater age than the males. Among males, a high percentage (71%) are mature at the age of 8 yr, while among females this does not occur until the age of 10 yr (65%). Total mortality for males and females was slightly higher in 1979 than in 1978. This increase could be related to the strong pressure being exercised by the gillnet fishery, since gillnets have a greater impact on the larger fish.

Tremblay, C. and Axelsen, F. 1981. Analyse de la population de flétan du Groenland du nord-ouest du golfe du Saint-Laurent (4RST) [Analysis of the Greenland halibut population in the northwest St. Lawrence Gulf (4RST) CAFSAC Res. Doc. 81/26: 30 p.
[In French]

The landings of the Greenland halibut peaked at 9, 219 MT in 1979, then dropped to 7,012 MT in 1980. Quebec catches more than 75% of the total Gulf landings and are derived from the inshore gillnet fishery (86%) and from the by catch of the shrimp fishery (13%). Commercial fishery data analysis shows the catch is composed of males (43 - 58 cm, 6 - 10 yrs) and of females (45 - 67 cm, 7 - 11 yrs). Analysis also showed that a good proportion of individuals of more than 8 yrs has reached a pre-spawning stage of maturity by Sept and Oct. A large number of recruits were found in the scientific cruise samples north of Anticosti I. in Oct 1980. The presence of prerecruits and of sexual mature individuals in the fall indicates that the species reproduces in the St. Lawrence Gulf. Fishing mortality is greater than 0.60 derived from commercial and scientific catch samples. Results from the samples show values of F are higher than the values of F max. These are in agreement with the drop in the local catch in 1980, the decrease in CPUE, as well as the drop in abundance of individuals more than 9 yrs.

Tremblay, C. and Axelsen, F. 1981. Biologie et pêche du flétan du Groenland (*Reinhardtius hippoglossoides*) Walbaum dans le golfe du Saint-Laurent [Greenland halibut *Reinardtius hippoglossoides* (Walbaum) biology and fishery in the Gulf of St. Lawrence]. Travaux sur les pêcheries du Québec. 48. 101 p.
[In French]

Tremblay, C. and Axelsen, F. 1982. Données sur la pêche, la biologie et l'abondance du flétan du Groenland (*Reinhardtius hippoglossoides)* dans le golfe du Saint-Laurent [Data on the fishery, biology and abundance of the Greenland halibut (Reinhardtius hippoglossoides) in the Gulf of St. Lawrence]. Cahier d'information (Québec (Province)). Direction generale des pêches maritimes. Direction de la recherche scientifique et technique. 98. 27 p.
[In French]

The Greenland halibut fishery in the Gulf of St. Lawrence has experienced considerable growth since 1975, catches having increased from 1544 T. in the year to 9219 T in 1979. The landings come mainly from Divisions 4S (65%), and are made largely by Quebec (70%). The size and age structure of the population is fairly stable. The bulk of the male population range between 40 and 58 cm (6 to 9 years of age), while the females range between 43 and 64 cm (6 to 10 years). The Greenland halibut in the Gulf of St. Lawrence are found mainly at depths of between 200 and 350 dm in 4 well-defined areas: Sept Iles, Laurentian Channel, Anticosti Channel and Esquiman Channel. Their distribution in May and June is largely (>80%) localized in Division 4S. The estimated abundance, on the basis of research cruises shows a decrease in biomass between 1977 and 1978, and stabilization between 1978 and 1979.

Tremblay, C., Portelance, B., and Fréchette, J. 1983. Inventaire au chalut de fond des espèces de poissons et crustacés dans l'estuaire maritime du Saint-Laurent [Bottom trawl survey of fish and crustaceans in the lower St. Lawrence River Estuary]. Cahier d'information (Québec (Province)). Direction générale des pêches maritimes. Direction de la recherche scientifique et technique). 103. 96 p.
[In French, English summary]

In this paper, the authors present the results of a survey of the finfish and the main species of shrimp *Pandalus borealis* found in the eastern section of the Laurentian Channel and on Les Escoumins shelf, both areas being located in the lower St. Lawrence Estuary. The main marine species they considered for the purpose of this analysis were: northern shrimp, Greenland halibut (*Reinhardtius hippoglossoides*), witch flounder (*Glyptocephalus cynoglossus*), American plaice, (*Hippoglossoides platessoides*) redfish (*Sebastes mentella*) and cod (*Gadus morhua*).

Trolle, K. 1985. Denmark (Greenland) request for scientific advice on management in 1986 of certain stocks in Subarea 1. NAFO SCS documents 85/7: 2 p.

Troncoso, D.G. and Paz, X. 2003. Transformed results for Greenland halibut from the surveys conducted by Spain in the NAFO Regulatory Area of Division 3NO, 1996-2002. NAFO SCR documents 03/8: 15 p.

Since 1995, a stratified random spring bottom trawl survey in the NAFO Regulatory Area of Div. 3NO was conducted by Spain. The depth strata surveyed was extended to 1464 m. The main purpose of the surveys was to obtain abundance and biomass indices and population structure for the commercial species in the area. In 2001, the trawl vessel was replaced in the realization of the trawls; so, the time series indices was transformed. The entire transformed series of abundance, biomass and length distribution for Greenland halibut are presented for the period 1996-2000, and the un-transformed data for the years 2001 and 2002. The standard deviations are shown for abundance and biomass. A decreasing in Greenland halibut (*Reinhardtius hippoglossoides*) biomass is observed in late years. A high percentage of juvenile individuals show good recruitment in recent years.

Troncoso, D.G., Román, E., and Paz, X. 2002. Results for the Greenland halibut in the Spanish Spring Survey in the NAFO Regulatory Area of Divisions 3NO, 1996-2001: abundance, biomass and population structure. NAFO SCR documents 02/4: 12 p.

Since 1995, a stratified random spring bottom trawl survey in the NAFO Regulatory Area of Div. 3NO was conducted by Spain. The depth strata surveyed was extended to 1464 m. The main purpose of the surveys was to obtain abundance and biomass indices for the commercial species in the area. The entire series of abundance and biomass for Greenland halibut (*Reinhardtius hipploglossoides*) are presented for the period 1996-2001. The indices calculated from the survey series shows an increase in Greenland halibut abundance and biomass until 1998, but in the following years these values tend to decrease. However, recruitment is good in the last years, although the number of individuals of length over 70 cm. is very low.

Troncoso, D.G., Román, E., and Paz, X. 2004. Results for Greenland halibut from the surveys conducted by Spain in the NAFO Regulatory Area of Divisions 3NO, 1996-2003. NAFO SCR documents 04/11: 16 p.

Since 1995, a stratified random spring bottom trawl survey in the NAFO Regulatory Area of Div. 3NO was conducted by Spain. In 2001, the trawl vessel was replaced in the realization of the trawls; so, the time series indices was transformed. The entire transformed series of mean catches, abundance, biomass and length distribution for Greenland halibut (*Reinhardtius hippoglossoides)* are presented for the period 1996-2000, and the non-transformed data for the years 2001-2003. The standard deviations are shown for abundance and biomass. The summed abundance and biomass based on conversion of the length frequencies are presented and compared to the estimates from the method used to convert the CPUE. A decrease in Greenland halibut (*Reinhardtius hippoglossoides*) biomass and abundance is observed in last years (2000-2003). A high percent of juvenile individuals could indicate a good recruitment in recent years.

Troyanovsky, F.M. and Lisovsky, S.F. 1995. Russian (USSR) fisheries research in deep waters (below 500m) in the North Atlantic. *In* Deep-water fisheries of the North Atlantic oceanic slope. *Edited by* A.G.Hopper. Kluwer Academic Publishers, Dordrecht (The Netherlands). pp. 357-365.

Russian investigations of the deep-water species of the Atlantic commenced in 1963 and have continued to 1993. The first investigations were carried out by fishing vessels and research vessels on Greenland halibut (*Reinhardtius hippoglossoides*) in the Barents Sea, and then on witch flounder (*Glyptocephalus cynoglossus*), in the western Atlantic. In 1967-68 a commercial fishery for roundnose grenadier (*Coryphaenoides rupestris*) and Greenland halibut started on the slope in the north west Atlantic. At this time there was also a fishery at Iceland for Greenland halibut. Since 1973 Russian vessels have been fishing on the ridges and underwater rises in the open areas of the North Atlantic for a variety of deep-water species. On these cruises the environmental conditions of temperature and salinity were recorded together with the biological data and bathometric and hydrographic information down to 2000 m. depth. Biological sampling was done with both mid-water trawls, bottom trawls, longlines and traps. Fish behaviour patterns and distribution have been studied using a manned submersible vehicle. Some of the results of these surveys are given together with estimates of the commercial catches between 1967 and 1991. In the peak year of 1971, 82,000 tonnes of roundnose grenadier were caught. The paper also makes some estimates of the biomass and suggests possible commercial catch levels of the main species of marketable value, which can be caught in the north east Atlantic outside of the economic zones of the coastal states.

Tsukamoto, Y., Ueno, Y., Minami, T., and Okiyama, M. 1995. Transforming specimens of two righteye flounders, *Atheresthes evermanni* and *Reinhardtius hippoglossoides*. Jap. J. Ichthyol. 41: 469-473.

Early ontogeny of the North Pacific flatfishes (family Pleuronectidae) has long been comprehensively studied (i.e. Pertseva-Ostroumova, 1961). However, information on early life history series is still incomplete for some species, such as *Atheresthes evermanni* and *Reinhardtius hippoglossoides*. Although pelagic larvae of these two species have been reported (Schmidt, 1904; Jensen, 1935; Pertseva-Ostroumova, 1961), transforming specimens have remained unknown. Recently, transforming specimens referable to these large sized righteye flounders were collected from the western North Pacific. In this paper, their external and some internal morphology is described, with some comments on their transformation. The specimens were fixed in 10% buffered sea water formalin. Counts and measurements followed Hubbs and Lagler (1958), and for osteological observations, 3 specimens of *A. evermanni* were stained using the method of Dingerkus and Uhler (1977). For this paper, metamorphosis was roughly divided into three stages, according to the degree of eye migration. The specimens are deposited in the Department of Zoology, National Science Museum (Nat. Hist.), Tokyo (NSMT-PL).

Tuene, S., Gundersen, A.C., Emblem, W., Fossen, I., Boje, J., Steingrund, P., and Ofstad, L.H. 2001. Maturation and occurrence of Atresia in oocytes of Greenland halibut (*Reinhardtius* *hippoglossoides*, Walbaum). NAFO SCR documents 01/166: 12 p.

Measurements of oocyte diameters and histological examinations were conducted on gonads of Greenland halibut (*Reinhardtius hippoglossoides*, Walbaum) females from East-Greenland (1997 and 1998), Faeroe Islands (1999) and Hatton Bank (1999). Morphometric measures of the oocytes revealed that the diameter of the largest yolk vakuole and the thickness of Zona radiata correlated well with oocyte diameter. Athretic oocytes were not found in immature gonads, but were observed in 70% of the gonads of sexually maturing and mature specimens. Atresia mostly affected the largest oocytes (500-800 mu) in maturing specimens and the smallest vitellogenic oocytes (600-1200 mu) in mature specimens. Atresia infrequently affected vitellogenic oocytes larger than 1200 mu . Intensity of atresia was negatively correlated with hepatosomatic index and with potential fecundity for the entire material, but no significant correlation was found within any area or year. There was also no difference found in oocyte morphometry or atresia between areas or years.

Tuene, S., Gundersen, A.C., Emblem, W., Fossen, I., Boje, J., Steingrund, P., and Ofstad, L.H. 2002. Maturation and occurrence of atresia in oocytes of Greenland halibut (*Reinhardtius hippoglossoides* W.) in the waters of East Greenland, Faroe Islands and Hatton Bank. *In* Reproduction of West-Nordic Greenland halibut. Studies reflecting on maturity, fecundity, spawning and TEP. *Edited by* A.C.Gundersen. Nordic Council of Ministers, Copenhagen (Denmark). pp. 39-71.

Measurements of oocyte diameters and histological examinations were conducted on gonads of Greenland halibut (*Reinhardtius hippoglossoides*, Walbaum) females from East-Greenland (1997 and 1998), Faroe Islands (1999) and Hatton Bank (1999). Morphometric measures of the oocytes revealed that the diameter of the largest yolk vacuole and the thickness of zona radiata correlated well with oocyte diameter. Atretic oocytes were not found in immature gonads. Atretic oocytes were observed in 70% of the gonads of sexually maturing and mature specimens. Atresia mostly affected the largest oocytes (500--800 mu) in maturing specimens and the smallest vitellogenic oocytes (600--1,200 mu) in mature specimens. Atresia infrequently affected vitellogenic oocytes larger than 1,200 mu . Intensity of atresia was negatively correlated with hepatosomatic index and with potential fecundity for the entire material, but no significant correlation was found within any area or year. No difference in oocyte morphometry or atresia between areas or years was found.

Tuene, S., Gundersen, A.C., and Hjörleifsson, E. 2002. Maturation and occurrence of atresia in oocytes of Greenland halibut (*Reinhardtius hippoglossoides* W.) in the waters of Iceland. *In* Reproduction of West-Nordic Greenland halibut. Studies reflecting on maturity, fecundity, spawning and TEP. *Edited by* A.C.Gundersen. Nordic Council of Ministers, Copenhagen (Denmark). pp. 73-95.

Ovaries were collected from females sampled randomly from the catches. The mean ungutted weight of 110 sampled females was 3500 g. The oocyte diameter distribution of the 34 females showed two peaks, one around 700 mu and the other around 1500 mu . There was overlap in weight and length between non-maturing and maturing fish. Within the maturing group there was not found any relationship between fish size and oocyte size. Atresia was observed in gonads in cortical alveoli stage, in early vitellogenesis and in later vitellogenesis. Atresia was not found in ovaries with oocyte diameters below 500 mu . Atresia was found in 60% of the individuals with leading oocyte cohort larger than 500 mu . Among the largest oocytes in the ovary, atresia was found in individuals that had a mean oocyte diameter of the leading cohort less than 1000 mu . Atresia among the smallest oocytes of the leading cohort was mainly found in individuals with oocyte diameter above 1400 mu . No apparent correlation was found neither between potential fecundity and atresia, nor between condition factor and atresia. Measurements of oocyte

diameter from histological sections correlated well with diameter measured by the standard method. Fecundity measured from the sections, and fecundity obtained from whole mount preparations were within a range of plus or minus 35% of each other. The patterns of atresia were the same as seen in other works on histology of Greenland halibut. Two main types of atresia were seen: One type affecting cortical alveoli stage or early vitellogenic stage that can seriously inflict or stop the maturation process in fish in puberty. The other type of atresia attacks the smallest vitellogenic oocytes and may result in a clear size separation between cohorts of oocytes in larger fish.

Turuk, T.N. and Postolaky, A.I. 1980. Feeding and food relations of some fish species in the Labrador and Newfoundland areas. NAFO SCR documents 80/70: 9 p.

Uozumi, Y. 1989. Japanese research report for 1988. NAFO SCS documents 89/13: 3 p.

Uozumi, Y. 1990. Japanese research report for 1989. NAFO SCS documents 90/15: 3 p.

Uozumi, Y. 1991. Japanese research report for 1990. NAFO SCS documents 91/14: 7 p.

Vaisman, A. 2001. Trawling in the mist. Industrial fisheries in the Russian part of the Bering sea. TRAFFIC International, Cambridge (UK). 101 p.

Recent, accurate, baseline information on fish stocks and catches in the Russian part of the Bering sea is often uncertain or unavailable with the consequence that fisheries management is lacking a sound foundation for decision-making. However, Russian authorities have increased quotas for some fish without an obvious biological basis for so doing. Bering sea is of critical importance to Russian fisheries, providing around half of the country's marine harvest in the 1990s. Target fisheries are Alaska pollock, crabs, cods, Pacific herring, rockfishes, halibuts and flounders, yellowfin sole and plaices, shrimps, commander squid. Recorded fisheries exports from Kamchatka have been increasing in volume, from 1995 to 1998, but the unit value of several of these commodities has dropped over this period. This, and the fact that a large proportion of fish is caught and sold without passing through state-approved channels, means that little income from fisheries is being harnessed by the government for re-investment in the industry. Legal and enforcement mechanisms in the Russian Federation are incapable of redressing the loss of billions of US dollars to illegal operators annually. The need is underlined to engage action on an international scale for a marine environment of special significance for the world.

Valdemarsen, J.W., Engaas, A., and Isaksen, B. 1985. Vertical entrance into a trawl of Barents Sea gadoids as studied with a two level fish trawl. ICES CM 1985/B:46: 16 p.

Catch figures of different demersal species (cod, haddock, saithe, etc.) in the cod-ends of a two level trawl were examined using variable height in the separating panel.

Vargas, J., Alpoim, R., Santos, E., and Ávila de Melo, A.M. 2000. Portuguese research report for 1999. NAFO SCS documents 00/16: 51 p.

Vargas, J., Alpoim, R., Santos, E., and Ávila de Melo, A.M. 2001. Portuguese research report for 2000. NAFO SCS documents 01/9: 40 p.

Vargas, J., Alpoim, R., Santos, E., and Ávila de Melo, A.M. 2003. Portuguese research report for 2002. NAFO SCS documents 03/7: 53 p.

Vargas, J., Alpoim, R., Santos, E., and Ávila de Melo, A.M. 2004. Portuguese research report for 2003. NAFO SCS documents 04/5: 50 p.

Vargas, J., Alpoim, R., Santos, E., and Ávila de Melo, A.M. 2005. Portuguese research report for 2004. NAFO SCS documents 05/6: 54 p.

Vaskov, A.A. and Igashov, T.M. 2003. Results from the Russian trawl survey on the Flemish Cap Bank (Division 3M) in 2002. NAFO SCR documents 03/9: 30 p.

Based on the results from the bottom trawl survey conducted by research and fishing vessel Remoifjord on the Flemish Cap Bank in May-June 2002, the estimations of groundfish species (redfishes, Greenland halibut, cod, flounders, grenadiers and skates) abundance and biomass and their distribution by depth are given. To compare the data, the results from the previous surveys since 1987 are presented in the paper. The data on length-age composition for the group of beaked redfishes *S. mentella* and *S. fasciatus* and for Greenland halibut are provided. The investigations were carried out in accordance with area stratification adopted in NAFO.

Vatulina, L.P. 1992. O promysle chernogo paltusa *Reinhardtius hippoglossoides matsuurae* i vozmozhnostyakh ego razvitiya v Okhotskom more [On the Pacific halibut, *Reinhardtius hippoglossoides matsuurae*, fishery and prospects for its development in the Sea of Okhotsk]. *In* Biologischeskie resursy Tikhogo okeana : sbornik nauchnykh trudov [Living resources of the Pacific Ocean]. *Edited by* A.A.Churikov, O.F.Gritsenko, and N.V.Klovach. VNIRO, Moscow (Russia). pp. 50-56.
[In Russian, English summary]

At present the major black halibut fishery of Russia is in the Sea of Okhotsk, the annual catch amounting to 9-16 thousand tons. Halibut is taken in the eastern part of the sea, on the slope of western Kamchatka and off the northern Kurils. Resources in traditional fishing areas do not permit the catch to be increased. At the same time halibut is known to occur throughout the sea and at least half of its stock is underexploited. Development of halibut fisheries on the eastern slope of Sakhalin and in the northern Okhotsk Sea is likely to increase the catch to 18-20 thousand tons. However, the bottom relief of most of the sea area does not permit bottom trawling, therefore development of longline and gill net fisheries is recommended.

Vazquez, A. 1992. Results from bottom trawl survey of Flemish Cap in July 1991. NAFO SCR documents 92/27: 17 p.

Vazquez, A. 1993. Results from bottom trawl survey of Flemish Cap in July 1992. NAFO SCR documents 93/19: 42 p.

Vazquez, A. 1994. Results from bottom trawl survey of Flemish Cap in July 1993. NAFO SCR documents 94/22: 42 p.

Vazquez, A. 1995. Results from bottom trawl survey of Flemish Cap in July 1994. NAFO SCR documents 95/26: 33 p.

Vazquez, A. 1996. Results from bottom trawl survey of Flemish Cap in July 1995. NAFO SCR documents 96/54: 27 p.

Vazquez, A. 1997. Results from bottom trawl survey of Flemish Cap in July 1996. NAFO SCR documents 97/28: 30 p.

Vazquez, A. 1999. Results from bottom trawl survey of Flemish Cap in July 1998. NAFO SCR documents 99/22: 37 p.

A stratified random bottom trawl survey of Flemish Cap was carried out in July 1998 up to a depth of 730 metres. Survey results are presented and compared with results of previous surveys in the series since 1998. Abundance at age indices are presented for cod. American plaice, redfish (*Sebastes mentella* and *S. fasciatus*) and Greenland halibut.

Vazquez, A. 2000. Results from bottom trawl survey of Flemish Cap in July 1999. NAFO SCR documents 00/9: 50 p.

A stratified random bottom trawl survey of Flemish Cap was carried out in July 1999 up to a depth of 730 metres. Survey results are presented and compared with results of previous surveys in the series since 1988. Abundance at age indices are presented for cod, American plaice, redfish and Greenland halibut. Results from a comparative trial between the survey gear (Lofoten) and a Campelen 1800 shrimp trawl are presented.

Vazquez, A. 2002. Catchability comparison between Lafoten and Campolen gears. NAFO SCR documents 02/74: 9 p.

During the EU bottom trawl survey on Flemish Cap in July 1999-2001, a comparative trial between the Lafoten survey gear and a Campelen 1800 shrimp trawl was carried out. Results are interpreted based on the main differences between both gears: the gear geometry, being the vertical opening of the Campelen gear the highest, the footrope, being the Lofoten the lightest, and the cod-end mesh size, being the Campelen one the smallest.

Vazquez, A. 2002. Results from bottom trawl survey on Flemish Cap of July 2001. NAFO SCR documents 02/12: 43 p.

A stratified random bottom trawl survey on Flemish Cap was carried out on July 2001 up to a depth of 730 metres. Survey results are presented and compared with results of previous surveys in the series since 1988. Abundance-at-age indices were presented for cod, American plaice, redfish and Greenland halibut.

Vazquez, A. and Gandaras, G.P. 1990. Spanish research report for 1989. NAFO SCS documents 02/7: 13 p.

Vazquez, A. and Iglesias, S. 1993. Spanish research report for 1992. NAFO SCS documents 93/14: 14 p.

Vazquez, F.J., Paz, F.J., Casas, J.M., Cardenas, E., Alvarez, E., and Fernandez-Arroyo, A. 1989. La alimentacion de la platija americana, flétan negro, gallineta nordica y el bacalao en Flemish Cap en julio de 1988 [Feed of American plaice, Greenland halibut, redfish and cod in Flemish Cap in July 1988]. Bol. Inst. Esp. Oceanogr. 5: pp. 43-56.
[In Spanish, English summary]

A randomly stratified bottom-trawl survey was conducted on Flemish Cap Bank (NAFO div. 3M) in July 1988. The stomach contents of 4 species were studied: 320 in American plaice (*Hippoglossoides platessoides*), 76 in Greenland halibut (*Reinhardtius hippoglossoides*), 203 in redfish (*Sebastes marinus*) and 468 in cod (*Gadus morhua*). In cod, the specimens were classified by age groups; in the others, by length classes. The food objects feed intensity index and prey occurrence index were determined in the 4 species.

Vazquez, A., Gandaras, G.P., Paz, J., Zamarro, J., and Cardenas, E. 1991. Spanish research report for 1990. NAFO SCS documents 91/16 : 22 p.

Vazquez, A., Perez-Gandaras, G., Paz, J., Zamarro, J., and Junquera, S. 1992. Spanish research report for 1991. NAFO SCS documents 92/13: 10 p.

Vazquez, A., Junquera, S., Paz, J., and Motos, L. 1994. Spanish research report for 1993. NAFO SCS documents 94/16: 13 p.

Vazquez, A., Ávila de Melo, A., and Saborido-Rey, F. 1998. Results from bottom trawl survey of Flemish Cap in July 1997. NAFO SCR documents 98/30: 38 p.

The Survey of Flemish Cap was carried out in 1996 on board R/V Cornide de Saavedra. A synoptic sheet of the survey with ship and gear characteristics is shown. This was the tenth survey of the series initiated by the EU in 1988. All surveys had a stratified random design following NAFO specifications. A total of 117 valid bottom trawls were made up to a depth of 720 metres. The survey covered adequately all strata of the bank. Total biomass of all species was calculated by the swept area method. The results are presented. Those amounts are assumed to underestimate real values but in different degrees, as a consequence of each species having a peculiar catchability and accessibility to bottom gears. In this framework, the total biomass estimated for 1995 has the minimum value of all the series. Redfish shows the highest annual variability due to probably its pelagic habitat, making accessibility to bottom gears to change more often than demersal or benthic species. American plaice, skates, and the genus Urophicis and witch flounder reached a biomass minimum in 1997. Greenland halibut was the single species that reach a maximum in 1997.

Veim, A.K., Sunnanaa, K., Sandberg, P., and Gullestad, P. 1994. Bycatch of juvenile fish in the shrimp fishery: management based on bioeconomic criteria. ICES CM 1994/T:14: 14 p.

The bycatch of juvenile fish can be a major problem in fisheries with small meshed trawls, such as fisheries for shrimp, (*Pandalus borealis*). A sorting grid that effectively removes most of the undersized fish has been developed for shrimp trawls and it is not legal to fish for shrimp in the Barents Sea without the use of this sorting grid. Apart from this, the existing catch-regulation of shrimp fishery in the Barents Sea is closing shrimp fisheries on fishing-grounds, where the bycatch of juvenile fish exceeds the criteria for allowable bycatch in numbers per ton of shrimp set by The Norwegian - Russian Fishery Commission. In this paper a new method for calculation of a criteria for closing shrimp fisheries based on both biological and economic considerations is established. This bio-economic approach is an alternative to the existing biological approach. The main concept in the bio-economic approach is that if the expected future value of the bycatch exceeds the value of the shrimp catches, the shrimp fishery should be closed. In this paper a joint criteria for allowable bycatch is developed and calculated, including all the commercially interesting species, (cod; *Gadus morhua*, haddock; *Melanogrammus aeglefinus*, redfish; *Sebastes mentella* and Greenland halibut; *Reinhardtius hippoglossoides*) whose juveniles are caught as bycatch in the shrimp fisheries in the Barents Sea.

Vernidub, M.F. and Panin, K.I. 1983. Some data on the systematic position and biology of a Pacific member of the genus Reinhardtius Gill. Can. Transl. Fish. Aquat. Sci. 5018: 33 p. [Translated from Russian/Traduction du russe vers l'anglais. Original appeared in/L'original a paru dans: Uchonyye zapiski LGU (Scientific Journal of the Leningrad State University). (15): 250-272, (1937)]

On the basis of biological data from specimens of Pacific black halibut, *Reinhardtius* from the Okhotsk and Bering seas, this species should be regarded as a subspecies, Reinhardtius hippoglossoides matsuurae, of the Greenland halibut, *Reinhardtius hippoglossoides*, a commercially valuable catch. Information on morphology, distribution, sexual maturity, age composition, and growth are provided.

Vilhjalmsson, H. and Magnusson, J.V. 1984. Report on the 0-group fish survey in Icelandic and East Greenland waters, August 1984. ICES CM 1984/H:66: 26 p.

Vinnichenko, V.I. 1998. On conditions of formation of Greenland halibut (*Reinhardtius hippoglossoides*) concentrations in the open Northwest Atlantic. ICES CM 1998/O:15: 5 p.

This paper presents results of deep sea fisheries investigations carried out during 60-80s onboard the former Soviet Union vessels in the areas of the Flemish Cap Bank and the Grand Newfoundland Bank. The abundance variation trend in Greenland halibut (*Reinhardtius hippoglossoides*) catches is considered. Information on environmental changes in the Northwest Atlantic during the last three decades is given. Data from deep sea surveys in Canadian waters are reported. Reasons for formation of commercial aggregations outside the 200-mile Canadian zone as well as for decline in halibut biomass in traditional fishing areas are investigated. Prospects of halibut fisheries in the open Northwest Atlantic are analysed.

Vinnichenko, V.I., Gorchinsky, K.V., and Lebedev, A.M. 2001. Results of the abundance and biomass assessment of Greenland halibut by the data from Russian trawl survey in the Northern Flemish Pass in 2000. NAFO SCR documents 01/10: 3 p.

The Russian stratified-random survey for Greenland halibut (*Reinhardtius hippoglossoides*) was carried out onboard MI-0703 "Onezhsky" in the northern Flemish Pass in 732-1 280 m depths in spring 2000. Total abundance and biomass of Greenland halibut constituted 36.9 mill. indiv. and 23.9 thousand tons respectively, over the area surveyed. With an increase in depth a proportion of Greenland halibut in catches reduced and catches of red hake, roughhead and roundnose grenadier increased. Length of halibut males varied from 24 to 72 cm and that of females, from 27 to 95 cm; the frequency of occurrence of specimens below 30 cm did not exceed 0.5%. The amount of females in catches was approximately 1.5 times higher than that of males. Above 99% of the individuals examined were immature.

Vis, M.L., Carr, S.M.A., Bowering, W.R., and Davidson, W.S. 1997. Greenland halibut (*Reinhardtius hippoglossoides*) in the North Atlantic are genetically homogeneous. Can. J. Fish. Aquat. Sci. 54: 1813-1821.

Greenland halibut (*Reinhardtius hippoglossoides*) have become of great importance to the Canadian fishery since the moratorium on northern cod (*Gadus morhua*), and an understanding of stock relationships among populations at the northern and southern extremes of their commercial range is crucial for proper management. Mitochondrial DNA sequence variation were compared among fish taken from throughout the Northwest Atlantic (Flemish Pass, the Grand Banks, Davis Strait, and northwest Greenland) with samples from the Gulf of St. Lawrence, Iceland, amd Norway. Within a 401 base pair portion of the cytochrome b gene, 22 genotypes were identified. Three of these occur at frequencies >10% and in the same samples, and genetic subdivision among samples is nil. Genetic distances among samples are not related to geographic distribution: pairwise differences between the Gulf sample and other western Atlantic samples exceed those for trans-Atlantic comparisons. These data suggest that there is sufficient mixing of Greenland halibut, not only within the NAFO regulatory area, but among sites in the North Atlantic generally, to prevent the development or maintenance of genetically independent stocks.

Vis, M.L., Carr, S.M., Bowering, W.R., and Davidson, W.S. 1999. Greenland halibut (*Reinhardtius hippoglossoides*) in the North Atlantic are genetically homogeneous. *In* Ecology, fisheries and management of Greenland halibut (*Reinhardtius hippoglossoides* (Walbaum)) in the Canadian Northwest Atlantic. *Edited by* W.R.Bowering. Univeristy of Bergen, Bergen (Norway). Thesis (Ph.D.) – University of Bergen. 9 p.

Greenland halibut (*Reinhardtius hippoglossoides*) have become of great importance to the Canadian fishery since the moratorium on northern cod (*Gadus morhua),* and an understanding of stock relationships among populations at the northern and southern extremes of their commercial range is crucial for proper management. We compared mitochondrial DNA sequence variation among fish taken from thoughout the Northwest Atlantic (Flemish Pass, the Grand Banks, Davis Strait, and Northwest Greenland) with samples from the Gulf of St. Lawrence, Iceland, and Norway. Within a 401 base pair portion of the cytochrome b gene, 22 genotypes were identified. Three of these occur at frequencies >10% and in the same relative abundances in all samples (except the Gulf of St. Lawrence). Genotype proportions do not differ significantly among samples, and genetic subdivision among samples (measured by the coancestry coefficient theta) is nil. Genetic distances among samples are not related to geographic distribution: pairwise differences between the Gulf sample and other western Atlantic samples exceed those for trans-Atlantic comparisons. These data suggest that there is sufficient mixing of Greenland halibut, not only within the NAFO regulatory area, but among sites in the North Atlantic generally, to prevent the development or maintenance of genetically independent stocks.

Vollen, T. and Albert, O.T. 2004. Pelagic occurrence of Greenland halibut studied by means of vertical longlines. ICES CM 2004/K:69: 8 p.

Vollen, T., Albert, O.T., and Nilssen, E.M. 2004. Diet composition and feeding behaviour of juvenile Greenland halibut (*Reinhardtius hippoglossoides*) in the Svalbard area. J. Sea Res. 51: 251-259.

The diet of trawl-captured juvenile Greenland halibut (*Reinhardtius hippoglossoides* Walbaum) from three locations on the western and northern coasts of Svalbard, Norway, in December 1995 and January 1996 is described. Stomach fullness was recorded for 1216 fish of 7 to 65 cm length, and stomach contents were analysed for 353 non-empty stomachs. The diet differed only slightly between the sampling areas and no differences were found between males and females. The overall percentage of empty stomachs (PES) was comparable to other nursery areas and lower than recordings from feeding and spawning areas. PES decreased and prey size increased as predator length increased. Fish and crustaceans dominated the diet, the most important prey species being Atlantic cod (*Gadus morhua*), polar cod (*Boreogadus saida*) and northern shrimp (*Pandalus borealis).* The relative importance of fish and crustaceans, respectively, was independent of predator length. However, a size-dependent variation in preferred prey was found, as smaller fish preyed upon small crustaceans and polar cod while larger individuals displayed a preference for northern shrimp, juvenile Atlantic cod, and other larger fish. Finally, there was a close resemblance between the length distribution of prey species from the trawl and from the stomachs.

Voronina, E.P. 2005. Structural characteristics of the seismosensory system in some representatives of the family Pleuronectidae (sensu Chapleau, and Keast, 1988). communication 3. Vopr. Ikhtiol. 45: 157-167.
[In Russian]

Waite, L. and Tallman, R.F. 1987. American plaice in NAFO Division 4T, a biological update. CAFSAC Res. Doc. 87/89: 22 p.

Waldron, K.D. and Favorite, F. 1976. Ichthyoplankton of the eastern Bering Sea. *In* Environmental assessment of the Alaskan continental shelf. Volume 2. Fish, plankton, benthos, littoral. Principal investigators' reports for the environmental assessment of the Alaskan continental shelf. Nov. 1976. NOAA, Boulder, CO.

Ichthyoplankton samples from a portion of the eastern Bering Sea were collected and analyzed. Ichthyoplankton for the 505 bongo and the neuston samples were received at the Northwest Fisheries Center during the first week of Sept and identification was begun.

The samples were from the continental slope west of the Pribilof Islands and from 1 station near Unimak Pass. The predominant sp from these stations has been walleye pollock. Larvae of other fish of commercial importance include those of Greenland turbot, arrowtooth flounder, and Pacific halibut. Capture of halibut larvae is of interest because they have been reported infrequently from the eastern Bering Sea.

Waldron, K.D. and Favorite, F. 1977. Ichthyoplankton of the Eastern Bering Sea. *In* Environmental assessment of the Alaskan continental shelf. Volume 9. Receptors – fish, littoral, benthos. Annual reports of principal investigators for the year ending March 1977. NOAA, Boulder, Co. pp. 628-682.

This paper presents results of the survey that was conducted by the Norwest and Alaska Fisheries Center in order to identify critical regions inhabited by eggs and larvae of commercially valuable fish in the eastern Bering Sea. Samples were collected at 56 stations with three samples collected at each station, viz. a neuston net sample, a 505-bongo net sample and a 333-bongo net sample, or a total of 168 samples. Fish eggs and fish larvae were sorted and identified from 112 of these, the neuston and the 505-bongo samples.

Walsh, S.J. 1984. Relative efficiency of two bottom trawls in catching juvenile and commercial-sized flatfishes in the Gulf of St. Lawrence Canada. J. Northwest Atl. Fish. Sci. 5: 181-188.

The relative efficiencies of a No. 36 Yankee shrimp trawl and a No. 41.5 Yankee otter trawl in catching 3 spp. of flatfishes [*Glyptocephalus cynoglossus*, witch flounder; *Hippoglossoides platessoides*, American plaice; *Reinhardtius hippoglossoides*, Greenland halibut] were compared from data collected during research-vessel surveys of the northeastern Gulf of St. Lawrence. The shrimp trawl outfished the otter trawl in catching juveniles (< 30 cm) of the 3 spp., the greatest differences being for witch flounder and American plaice. The performance of the shrimp trawl, without and with a tickler chain attached to the footrope, in catching juvenile and commercial-sizes (.gtoreq. 30 cm) flatfishes was evaluated from a series of replicate tows. Marked increases in the catches of juveniles were observed for witch flounder and American plaice but not for Greenland halibut with the use of a tickler chain.

Walsh, S.J. and Bowering, W.R. 1980. Comparative histological and visual observations on oogenesis and sexual maturity of the Greenland halibut in northern Labrador waters. NAFO SCR documents 80/82: 13 p.

Walsh, S.J. and Bowering, W.R. 1981. Histological and visual observations on oogenesis and sexual maturity in Greenland halibut off Northern Labrador. Northwest Atl. Fish. Organ. Sci. Counc. Stud. 1: 71-75.

The accuracy of determining maturity stages of female Greenland halibut (*Reinhardtius hippoglossoides*) by visual examination in the field is essential to understanding the maturation cycle and onset of first spawning. The accuracy of visual observations on different stages of ovarian maturity can be enhanced by histological analysis. The main sources of error in the sample relate to the problem of distinguishing fish maturity for the first time, and fish recovering from a previous spawning.

Walsh, S.J. and Hickey, W.H. 2000. Review of bottom trawl cod-end mesh selection studies in the Northwest Atlantic. NAFO SCR documents 00/49: 5 p.

In recent years there have been requests from Fisheries Commissions for information and advice on the effects of changing mesh size regulations for various groundfish species in the NAFO area. The literature was searched for results of bottom trawl cod-end mesh selection studies for Atlantic cod (*Gadus morhua*), American plaice (*Hippoglossoides platessoides*), yellowtail flounder (*Limanda ferruginea*) and Greenland halibut (*Reinhardtius hippoglossoides*). With one exception all studies were restricted to the Northwest Atlantic. In some cases when data were available and no parameters estimated, the authors estimated them using a logistic model.

Walsh, S.J., Foster, J.J., Wang, H., and Brothers, G. 2000. Results of the Canadian 145 mm diamond cod-end mesh selection experiments for Greenland halibut in the NAFO area. NAFO SCR documents 00/66: 9 p.

Mesh selection experiments for Greenland halibut were carried out aboard a Canadian deepsea trawler to determine the selectivity parameters of 145-mm diamond mesh cod-end. A common bottom trawl used for fishing Greenland halibut was redesigned as a touser trawl with a 50-mm control mesh. Fourteen successful hauls of approximately 4-hour duration were made under commercial fishing conditions in depths ranging from 978 to 1283 m. Selection lengths at L25% was estimated to be 44.04 cm, at L 50% 47.74 cm and at L75% 51.45 cm with a selection range (SR) of 7.41 and a selection factor (SF) of 3.29.

Warren, W., Brodie, W., Stansbury, D., Walsh, S.J., and Orr, D. 1997. Analysis of the 1996 comparative fishing trial between the Alfred Needler with the Engel 145 trawl and the Wilfred Templeman with the Campelen 1800 trawl. NAFO SCR documents 97/68: 12 p.

A comparative fishing trial was done in early 1996 between the Wilfred Templeman with the Campelen net and its sister ship, the Alfred Needler with the Engel net. It was assumed that there was no difference between vessels -- only differences between the fishing gear. In addition to the 5 species studied in a 1995 trial, namely Atlantic cod (*Gadus morhua*), American plaice (*Hippoglossoides platessoides*), witch flounder (*Glyptocephalus cynoglossus*), Greenland halibut (*Reinhardtius hippoglossoides*), beaked redfish (*Sebastes mentella* and *S. fasciatus*), yellowtail flounder (*Limanda ferruginea*) was included in the 1996 comparisons. The results of the 1996 trial are reported in this paper. The authors question whether the estimated relationships are accurate enough to be used. In the mid-length range the answer is probably yes, but problems remain with the shorter and longer lengths. Since the Engel was not effective at catching the very short lengths, the practical solution is to determine a lower bound on length with no attempt at conversion for lengths below this. Improvement for the longer lengths requires adequate numbers of fish of such lengths to be caught. An alternative is to specify a constant value of the conversion factor for fish above a certain length. The nature of the chosen function is such that any realistic choice of these values would have little effect on the main body of the fit.

Warren, W.G. 1996. Report on the compartive fishing trial between the Gadus Atlantica and Teleost. NAFO SCR documents 96/28: 16 p.

Equations are developed for converting catches at length of five major groundfish species, obtained by the Gadus Atlantica using 30 minute tows with Engel 145 High Life otter trawl to Teleost equivalents (15 minute tows with the Campelen 1800 shrimp trawl). Paired tows were employed and criteria developed for determining whether one vessel fished on a aggregation essentially missed by the other vessel; such pairs were omitted from the final analysis. Bootstrap distributions were used for estimating the precision of the conversions. Because the Campelen 1800 is more efficient at catching small fish than the Engel 145 and because of the current scarcity of larger fish, extrapolation in either direction beyond the ranges indicated cannot be justified.

Warren, W.G. 1997. Report on the comparative fishing trial between the Gadus Atlantica and Teleost. Northwest Atl. Fish. Organ. Sci. Counc. Stud. 29: 81-92.

Equations are developed for converting catches at length, of five major groundfish species, obtained by the RV Gadus Atlantica using 30 minute tows with Engel 145 High Lift otter trawl to RV Teleost equivalents (15 minutes tows with the Campelen 1800 shrimp trawl). Paired tows were employed and criteria developed for determining whether one vessel fished on a aggregation essentially missed by the other vessel; such pairs were omitted from the final analysis. Bootstrap distributions were used for estimating the precision of the conversions. Because the Campelen 1800 was more efficient at catching small fish than the Engel 145 and because of the current scarcity of larger fish, extrapolation in either direction beyond the ranges indicated cannot be justified.

Weslawski, J.M. and Kulinski, W. 1989. Notes on fishes in Horsnund Fjord area Spitsbergen, Norway. Pol. Polar Res. 10: 241-250.

During marine ecological surveys conducted by Polish expeditions in South Spitsbergen area 14 fish species were collected. The length frequency, the diet and some other ecological informations are presented for the common species. [The following species are discussed: *Myoxocephalus scorpius*, *Liparis liparis*, *Boreogadus-saida*, *Lumpenus lampraeteformis*, *Clupea harengus*, *Eumicrotremus spinosus*, *Icelus bicornis*, *Reinbarditius hippoglossoides*, *Anarchichas-sp.*, *Triglops pingeli*, *Bethosema glaciale*, *Lumpemus ampraeteformis*, *Gadus morhua*, *Careproctus reinhardti*.]

Widera, L. 1979. Composition of fatty acids in lipids of a gelatinous meat of the *Reinhardtius hippoglossoides*. Can. Transl. Fish. Aquat. Sci. 4476: 9 p.
[Translated from Polish :klad Kwasow Tluszczowych w Lipidach Galaretowatego Miesa Kulbaka Czarnego (*Reinhardtius hippoglossoides*)]

Pathologically altered gelatinous meat of the *Reinhardtius hippoglossoides* characterizes undesirable acid composition of lipidic fraction. The composition of this fraction,especially a high content of polyene acids (45.1%) and C:20:5 and C 22:6 (38.7%) is one of the indices of improper sanitary quality of gelatinous meat. The obtained results can represent the relationship between the composition of acidic lipids of meat and a healthy state of fish. In the course of pathological processes fundamental changes appear in it, mainly due to some disturbances in lipid metabolism.

Widera, L. and Trenkner, E. 1978. Wystepowanie grzybow z rodzaju Cryptococcus w zmienionych chorobowo narzadach wewnetrznych kulbaka czarnego [The occurrence of fungi of the genus Cryptococcus in diseased internal organs of Greenland halibut]. Acta Mycol. 14: 135-142.
[In Polish, English summary]

Psychrophilic C. spp. were found in the kidneys and livers of Greenland halibut (*Reinhardtius hippoglossoides*), caught in the Labrador and Newfoundland regions. The presence of these spp. may be correlated with pathological changes, including degeneration in liver tissues, found in the 2 organs.

Wieland, K. 1991. Distribution of larval and 0-group fish off west Greenland in summer and autumn 1989 and 1990. NAFO SCR documents 91/35: 10 p.

Accompanying to a research project focused on the interaction of fish stocks off West Greenland pilot studies on the distribution of larval and 0-group fish have been carried out in summer 1989 and in summer and autumn 1990. In both years, larvae and 0-group fish of cod as well as redfish larvae were nearly absent in the samples taken. Greenland halibut larvae were found in summer 1989 and 1990 and seemed to occur exclusively in the upper 50m preferring temperatures not below 2C. In autumn 1990 considerable numbers of young redfish occurred. Off Southwest Greenland they were most abundant close to the coast, whereas in the northern region high densities were observed predominantly at the outermost stations.

Wieland, K. 2004. Recruitment of northern shrimp (*Pandalus borealis)* off West Greenland in relation to spawning stock size and environmental variation, 1993-2004. NAFO SCR documents 04/74: 9 p.

Standard and modified Ricker stock-recruitment functions incorporating environmental variables were compared in order to examine the effect of stock size, mean female size, predator biomass and temperature on recruitment at age 2 using female biomass corrected for the temperature-dependent of maturity and, alternatively, egg production as a measure of parental stock size. The standard Ricker models represented the observed recruitment not very well. Much better fits were obtained when environmental variables were incorporated in the stock-recruitment relationship. In addition to parental stock size, significant variables were mean female length, bottom temperature in the year the larvae settled and biomass of Greenland halibut (*Reinhardtius hippoglossoides*) as a proxy for predation on the 1-group. The results suggest that recruitment will be at or even below average in the coming three years despite a high level of female biomass. This interpretation should, however, be taken with some caution as the analysis was based on a short time series.

Wierzbicka, J. 1986. *Paramyxoproteus reinhardti* gen.n. et sp.n. (Bivalvulida, Myxospora), a parasite of *Reinhardtius hippoglossoides* Walbaum, 1792. Acta Protozool. 25: 227-234.

Paramyxoproteus reinhardti n.g., n.sp. is described from the urinary bladder of *R. hippoglossoides*, caught off Labrador, NW Atlantic and in the Barents Sea. The new genus is characterized by the inverted pyramid shape of the spores, some of which have lateral extensions of valves of different sizes and shapes, a straight suture line oblique to the longitudinal axis of the spore and 2 spherical polar capsules in the anterior part of the spore, in the suture plane. Paramyxoproteus differs in suture line characteristics and position of polar capsules from Conispora, Bipteria, Myxoproteus and Schulmania. *P. reinhardti* is also differentiated from various species of these genera. 4 species are transferred from Myxoproteus to the new genus as *P. cordiformis* n.comb., *P. hubbsi* n.comb., *P. rosenblatti* n.comb. and *P. moseri* n.comb. *M. meridionalis* is synonymized with *C. renalis*.

Wierzbicka, J. 1988. Parasite fauna of the blue halibut (*Reinhardtius hippoglossoides* Walbaum 1792) from selected districts of its distribution area. Szczecin, Poland, Akademia Rolnicza. Rozprawy; 114. 87 p.
[In Polish, English and Russian summary]

The parasite fauna (including protozoa, helminths and crustaceans) of 155 and 106 *R. hippoglossoides* from the Labrador fishing grounds and the Barents Sea, respectively, were examined. A total of 22 species of parasites were recorded; 19 from Labrador and 18 from the Barents Sea. One species was found only in the Labrador area and 3 only in the Barents Sea. The prevalence levels of some species were different in the 2 areas. Prevalence of *Anisakis simplex* varied significantly with host age. *Phocanema decipiens* larvae were found in the muscles, liver and gonads of the fish. Both these species were also present in *R. hippoglossoides* (100% prevalence) from the Bering Sea (Pacific Ocean), where a smaller scale survey in 1980 revealed the presence of 21 species of parasites, some of which were absent in fishes from the Atlantic. *Myxidium incurvatum, Hemiurus appendiculatus* and the crustacean *Acanthochondria* sp. are recorded for the first time for *R. hippoglossoides.* The shape and size of Ortholinea divergens spores differed from those described in the literature. *Ceratomyxa drepanopsettae, Paramyxoproteus reinhardti, M. incurvatum, Grillotia erinaceus, H. appendiculatus* and the crustaceans *Hatschekia* sp. (probably a new species) and *Acanthochondria* sp. are recorded for the first time for the North Pacific.

Wierzbicka, J. 1989. *Hatschekia reinhardtii sp. nov.* (Copepoda, Hatschekidae), a parasite of Greenland halibut, *Reinhardtius hippoglossoides* (Walbaum, 1792). Acta Ichthyol. Pisc. 19: 107-116.

A detailed description of morphology of males and females of *Hatschekia reinhardtii* sp. nov., a hitherto unknown crustacean species, is given. The parasites were found on gills of the Greenland halibut, *Reinhardtius hippoglossoides.* The fish were caught in the eastern Bering Sea (North Pacific). Data on infection intensity and incidence are given as well.

Wierzbicka, J. 1990. Parasitic Protozoa of a Greenland halibut *Reinhardtius hippoglossoides* (Walbaum, 1792). Acta Ichthyol. Pisc. 20: 91-98.

A detailed description of morphology of three protozoan species found in the gall bladder and urinary bladder of the Greenland halibut is given. The fishes were caught in the North Atlantic and the Pacific. Drawings of spores and their dimensions are also given. One of the four found species is described for the first time in the Greenland halibut.

Wierzbicka, J. 1991. An analysis of parasitic fauna of Greenland halibut, *Reinhardtius hippoglossoides* (Walbaum, 1792) in different age groups. Acta Ichthyol. Pisc. 21: 31-41.

So far, parasitological studies of the Greenland halibut, *Reinhardtius hippoglossoides* (Walbaum, 1792) refered mainly to know a fauna of parasites of the host and a degree of infestation with particular parasites. The aim of undertaken invastigations is to complete the lack of data on parasitic fauna of the host under discussion, according age of fishes. For the present study was used relatively comprehensive material from off the Labrador and the Barents Sea and an analysis of infestation in different age groups was made.

Wierzbicka, J. 1991. Parasites fauna of the Greenland halibut, *Reinhardtius hippoglossoides* (Walbaum, 1792) from Labrador area. Acta Ichthyol. Pisc. 21: 21-29.

Nineteen parasite species, belonging to: Protozoa, Monogenea, Cestoda, Trematoda, Nematoda, Acanthocephala and Crustacea, were recovered from the examined specimens of Greenland halibut (*Reinhardtius hippoglossoides*) from Labrador fishing grounds. Prevalence and intensity of infection of particular parasites as well as their location in or on the host were determined. Attention was given to parasites harmful for humans.

Wierzbicka, J. 1991. Parasitic fauna of blue halibut (*Reinhardtius hippoglossoides* (Walbaum, 1792)) from selected regions of species occurrence. Can. Transl. Fish. Aquat. Sci. 5520: 116 p.
[Translated from Polish in Szczecin Diss. 114, p. 1-82, 1988]

The purpose of this paper is to make a detailed study of parasitic fauna of blue halibut *Reinhardtius hippoglossoides* from the North Atlantic or, to be more precise, from two water regions which are distanced from one another, i.e., from the Labrador region and from the Barents Sea, and to include all the systematic groups of parasites. This study compared parasitic fauna of blue halibut from the two ecologically different environments of the North Atlantic given above. The adopted framework thus also made it possible to supplement missing data on the parasitic fauna of this host in relation to fish age.

Wierzbicka, J. 1992. Parasitic fauna of Greenland halibut, *Reinhardtius hippoglossoides* (Walbaum, 1972) from the Barents Sea. Acta Ichthyol. Pisc. 22: 31-37.

Surveys on Greenland halibut from the Barents Sea show presence of 18 parasitic species belonging to: Protozoa (4 species), Cestoda (2), Trematoda (5), Nematoda (3), Acanthocephala (3), and Crustacea (1 species). Infestation extensivity and intensivity of the tested fish population was given as well as location of parasite within the host. Two species pathogenic for man were found.

Wierzbicka, J. and Piasecki, W. 2000. Redescription of *Pseudacanthocotyla williamsi* (Price, 1938) (Monogenea) from Greenland halibut, *Reinhardtius hippoglossoides* (Walbaum, 1792). Acta Ichthyol. Pisc. 30: 93-98.

In the course of a parasitological survey carried out on Greenland halibut, *Reinhardtius hippoglossoides* (Pleuronectiformes) from the eastern part of the Bering Sea (north Pacific) a single specimen of a monogenean fluke was found. The parasite, later identified as *Pseudacanthocotyla williamsi* has never been found on a Greenland halibut. This fish species has been considered an atypical host for all monogeneans of the family Acanthocotylidae. The present work contains a detailed redescription of the parasite found.

Woll, A.K. and Boje, J.2000. Greenland halibut in east Greenland waters : recruitment studies and mapping of nursery grounds. TemaNord 2005:585: 167 p.

The catch-at-age data for Greenland halibut in Subarea 2 and Divisions 3KLMNO were revised at the June 2000 meeting of the Scientific Council of the North Atlantic Fisheries Organization. A separable model was used to examine the structure of the new data set and investigate trends in selection. Extended Survivors Analysis, calibrated using Canadian and European Union survey information, is used to assess the current status of the stock.

Woll, A.K., Boje, J., Holst, R., and Gundersen, A.C. 1998. Catch rates and hook and bait selectivity in longline fishery for Greenland halibut at East Greenland. ICES CM 1998/O:28: 13 p.

A joint Norwegian-Greenland longline survey was conducted in East Greenland August 1997, using different hook types. The Norwegian longline fleet uses most commonly hook type EZ 12/0 hook. This hook was compared to three different versions of circle 14/0 hooks. Catches from a total of 66 040 hooks composing 3 845 Greenland halibut (*Reinhardtius hippoglossoides*) were used in the analyses. In average the CPUE was 281 kg/1000 hook for the EZ hook. The CPUE for the circular hooks was somewhat higher making an overall significant difference in CPUE between the EZ hook and the circle hooks. The bait used during the survey was squid apart from a few settings where squid and grenadier was used in combination. The CPUE of Greenland halibut was 25% higher when using grenadier bait probably due to a higher average size of Greenland halibut. The grenadier bait gave very little bycatch Catches by EZ 12/0 hook and a circle 14/0 hook were compared in order to examine size selectivity. Using the SELECT approach expected proportions were fitted to the observed proportions for five different models of selectivity. All models resulted in almost identical fits. The absence of non-selective data requires the choice of selectivity curve to be based on specific knowledge on the capture process. Since the selectivity curves cannot be determined unambiguously, none of the applied curves can be preferred.

Woll, A.K., Boje, J., Holst, R., and Gundersen, A.C. 2001. Catch rates and hook and bait selectivity in longline fishery for Greenland halibut (*Reinhardtius hippoglossoides*, Walbaum) at East Greenland. Fish. Res. 51: 237-246.

A joint Norwegian-Greenland longline survey was conducted at East Greenland in August

1997, using different hook and bait types. Most Norwegian longliners use hooks of the type EZ 12/0. This hook was compared to three versions of a new circle 14/0 hook. A total catch of 2899 Greenland halibut from 45,760 hooks baited with squid were used in the hook selectivity analyses. In average, CPUE was 281 kg/1000 hook for the EZ hook. CPUE for the circular hook was 36% higher making an overall significant difference in CPUE between the EZ hook and the circle hooks. On 6630 hooks squid and grenadier were used alternately. The CPUE of Greenland halibut was 25% higher for grenadier bait. The grenadier bait resulted in a reduction in bycatch compared to the squid bait (1.1 and 20.7% by numbers, respectively). Catches by EZ 12/0 hook and one of the circle 14/0 hooks were compared in order to examine size selectivity. Using the SELECT approach, expected proportions were fitted to the observed proportions for five different models of selectivity. All models resulted in almost identical fits. The absence of non-selective data requires the choice of selectivity curve to be based on knowledge about the capture process. Since the selectivity curves cannot be determined unambiguously in this study, none of the estimated curves are preferred for the other.

Yamada, H., Okada, K., and Jørgensen, O. 1988. Distribution, abundance and size composition of Greenland halibut estimated from a stratified-random trawl survey off West Greenland in 1987. NAFO SCR documents 88/34: 6 p.

Yamamura, Y. and Muto, S. 1960. Tohoku kaiku-san teigyorui no Vitamin A ganyuuryou [Vitamin A contents of the bottom fish produced in the Tohoku Sea region]. Bull. Tohoku Reg. Fish.Res. Lab. 16: 150-163.
[In Japanese]

The vitamin A contents of the bottom fishes and their food-organisms:- a species of flounder (B JORDAN et STARKS; a species of flounder (Hireguro), *Glyptocephalus stelleri* (Schmidt); the shark-skin flounder (Samegarei), *Clidoderma asperrimum* (Temmink et Schlegel); the oil sole (*Athresthes evermanni* Jordan et Starks; the coral rock fish (Kichiji), *Sebastolobus macrochir* (Gunther); the rock cod (Menuke), *Sebastodes* sp.; a species of flounder (Ezokarasugarei), *Reinhardtius hippglossoides* (Walbaum); a species of cod (Itohikidara or Ukeguchidara) *Laemonema longispes* Schmidt - which live in the deep water of the Tohoku sea region, were studied since 1951 in relation with the catch statistical and biological studies carried out by the HACHINOHE branch of the Tohoku regional fisheries research laboratory, employing the Carr-Price method for the liver and visceral oils and Fujita-Hirao's method for meat and food-organisms. The results are summarized in Tables 1-10 and Tables 11-15.2. Linear increases of the vitamin A against the body-length were observed by plotting the data of the liver and the visceral oil of these fishes on the semi-logarithmic paper.Putting the maximum accumulation of the vitamin A, Y, the initial value, YâŠ,0 and the body-length, l, we have:Y=YâŠ,010 delta [super] where, delta denotes a coefficient to attain the maximum accumulation of the vitamin A.The values of delta lie between 0.074-0.081 for four species except the coral rock fish.3. The Vitamin A contents of meat fluctuate within 6-20 percent of the total amount of the fish body in the case of Kichiji, the B and the Samegarei, while that of the oil sole and the rock cod are very scanty.4. Vitamin A analysis were also made for the food-organisms separated from the stomachs of these bottom fishes and is summarized in Table 15.It will be seen from Table 15 that the differences of vitamin A contents are not so large among these species, e.g., crustaceas, annelidas, polychaetas, echinodermatas or cephalopods, but fairly high potency are estimated in fishes, though there is distinction that some species have carotenoids but others have no carotenoids.

Yang, M.-S. 1991. Pictorial guide to the gill arches of gadids and pleuronectids of the eastern Bering Sea. Alaska Fisheries Science Center, National Marine Fisheries Service. Seattle, Wash. AFSC processed report; 91/15. 30 p.

Yang, M.S. and Livingston, P.A. 1988. Food habits and daily ration of Greenland halibut, *Reinhardtius hippoglossoides*, in the eastern Bering Sea. Fish. Bull. (Wash.D.C.) 86: 675-690.

This study shows that diet of Greenland halibut varies mainly by depth and size, and that size of prey fish increases as the Greenland halibut increases in size. Walleye pollock, *Theragra chalcogramma*, was the most important prey (58% by weight of the total stomach content). Squids (mainly *Berryteuthis sp.*) were the second most (20% by weight) important food of Greenland halibut. Zoarcids and some deep-water fishes (e.g., bathylagids, myctophids, macrourids) were also important food for Greenland halibut 30-69 cm long. Euphausiids were only important as food (64% by weight) of the fish < 20 cm collected in the continental shelf < 200 m deep.

Yano, K. and Dahlheim, M.E. 1995. Killer whale, *Orcinus orca*, depredation on longline catches of bottomfish in the southeastern Bering Sea and adjacent waters. Fish. Bull. (Wash.D.C.) 93: 355-372.

Depredation of bottomfish on longline catches by killer whales, *Orcinus orca*, has been documented throughout the Bering Sea. Stations where repeated interactions with killer whales had been noted were examined during Japan-U.S. cooperative longline research surveys conducted from 1980 to 1989. During vessel surveys in 1988, killer whales were shown to depredate Greenland turbot, *Reinhardtius hippoglossoides*, sablefish, *Anoplopoma fimbria*, arrowtooth flounder, *Atheresthes stomias*, Pacific halibut, *Hippoglossus stenolepis*, and searcher, *Bathymaster signatus*, selecting the largest fish available for each species. Depredation rate, based on averages of total catch, was higher than calculated from direct counts of damaged fish. The average annual monetary loss to the survey calculated over a 4-month research season as a result of killer whale predation for the years 1982 through 1988 was estimated to range from $2,982 to $34,571.

Yano, K. and Jørgensen, O. 1992. Results of two stratified random bottom trawl surveys at West Greenland in 1991. NAFO SCR documents 92/48: 14 p.

Yatsu, A. and Jørgensen, O. 1988. Distribution and size composition of Greenland halibut, *Reinhardtius hippoglossoides* (Walb.), from a bottom trawl survey off east Greenland in 1987. ICES CM 1998/G:62: 8 p.

A stratified-random bottom trawl survey was carried out off East Greenland in the autumn 1987. A total of 63 hauls was made with a total catch of 707 Greenland halibut (*Reinhardtius hippoglossoides*). This paper provides information on distribution, abundance, size, and age composition and length at age, together with biomass estimates by strata.

Yatsu, A. and Jørgensen, O. 1989. Distribution, abundance, size, age, gonad index and stomach contents of Greenland halibut (*Reinhardtius hippoglossoides)* off West Greenland in September/October 1988. NAFO SCR documents 89/31: 12 p.

A stratified random trawl survey was carried out off West Greenland (NAFO Division 1A-1D) at the depths between 200 and 1500 m in September and October, 1988 by a Japanese stern trawler. This paper presents a part of the results.

Yatsu, A. and Jørgensen, O.A. 1989. Groundfish biomass estimates and biology of redfish (*Sebastes mentella and Sebastes marinus*) and Greenland halibut (*Reinhardtius hippoglossoides*) from a stratified-random trawl survey off east Greenland in 1988. ICES CM 1989/G:25: 13 p.

In July 1988, a stratified-random trawl survey was carried out off East Greenland by the Japanese R/V Shinkai Maru . The survey covered the area between 63 degree 30'N and 65 degree 30'N latitude, depth ranging 200-1,400 m (54,446 km super(2)). A total of 33 stations were trawled. *Sebastes mentella* was the most abundant species with an estimated biomass of 86,000 t, followed by *Sebastes marinus* (33,000 t) and Greenland halibut (*Reinhardtius hippoglossoides*) (14,000 t). Distributions, abundance, and size compositions of the above 3 spp. were presented. The "oceanic" stock of *Sebastes mentella* was not covered by the present survey.

Yatsu, A. and Jørgensen, O. 1989. West Greenland groundfish biomasses estimated from a stratified-random trawl survey in 1988. NAFO SCR documents 89/30: 7 p.

The purposes of the survey were to estimate groundfish biomasses and to collect information on the distribution, size composition, and biology of major species off West Greenland as well as on hydrography. In 1988, the main interest was put upon the Greenland halibut.

Yatsu, A., Yamada, H., and Jørgensen, O. 1988. Length-weight relationship, condition factor, gonad index and stomach contents of Greenland halibut, *Reinhardtius hippoglossoides*, around Greenland in 1987. NAFO SCR documents 88/32 rev.: 12 p.

Yetman, L and Staubitzer, D. 1991. Deepwater turbot survey -- northeast coast of Newfoundland, 1990. Project report (Canada. Dept. of Fisheries and Oceans. Newfoundland Region. Fisheries Development Division); FDD 1990-148. 30 p.

In the summer of 1990, two commercial fishing vessels were each chartered for 16 days and directed to fish for turbot, *Reinhardtius hippoglossoides* in deepwater off the Northeast coast of Newfoundland, using gillnets. Observers aboard the vessels were required to keep accurate records of all fishing locations, catch rates, and water depths. The information collected was used to assess the potential of such fishing operations in the area. The results of this survey indicate that regardless of water depth (700 to 1,300 metres), the use of larger gillnet mesh sizes (7.5" and 8.0") increases the overall yield of turbot per net by increasing the size of the fish captured. The larger mesh gillnets also had a lower occurrence of undesirable by-catches.

Yokawa, K. 1992. Japanese research report for 1991. NAFO SCS documents 92/18: 4 p.

Yokawa, K. 1993. Japanese research report for 1992. NAFO SCS documents 93/13: 4 p.

Yokawa, K. 1994. Japanese research report for 1993. NAFO SCS documents 94/14: 3 p.

Yokawa, K. 1995. Japanese research report for 1993. NAFO SCS documents 95/12: 4 p.

Yokawa, K. and Koga, J. 1995. Result of a deep water survey in the NAFO regulatory area in the spring of 1995, with emphasis on Greenland halibut. NAFO SCR documents 95/48: 12 p.

Since 1990, the souther sub-stock of Greenland halibut has become the target of a trawl fishery. Particularly in the NAFO Regulatory area, catch of Greenland halibut raised drastically after 1990 and these high level catch caused a concern that this sub-stock may experience the fate as the northern cod stock. In spite of this situation, insufficient amount of information on a status of Greenland halibut stock in the deepwater area of Subareas 2 and 3 at the time of last June meeting of the NAFO Scientific Council in 1994 prevented the Council from giving an appropriate level of TAC.

Yokawa, K. and Kouya, I. 1996. Japanese research report for 1995. NAFO SCS documents 96/13: 5 p.

Yokawa, K. and Satani, M. 1997. Results of a stratified random bottom trawl survey in NAFO Divisions 2GH in 1996. NAFO SCR documents 97/23: 19 p.

Southern sub-stock of Greenland halibut has been a main target of the bottom trawl/gill net fisheries since 1990 especially in the NAFO Regulatory Area. While recent trend of over exploitation of this sub-stock was apparent, the Scientific Council of NAFO could not find an appropriate effort level on this sub-stock. Part of the reason for this can be attributed to the shortage of survey coverage on this sub-stock. This documents reports the result of a stratified random bottom trawl survey in NAFO Divs. 2GH, where no scientific survey has been conducted in recent years, during August 1996 conducted under the cooperation between Japan and Canada. The aim of the survey was to estimate stock sizes and to obtain information on distribution, size composition and biology of Greenland halibut and other demersal fishes such as roundnose grenadier and beaked redfish in Divs. 2GH.

Yokawa, K., Shimizu, H., Jørgensen, O., and Yamada, H. 1995. Results of a stratified random bottom trawl survey off West Greenland in 1994. NAFO SCR documents 95/23: 12 p.

Since 1987 Japan Marine Fishery Resource Research Center (JAMARC) and Greenland Fisheries Research Institute (GFRI) have conducted cooperative trawl surveys off West and East Greenland. In 1994 one stratified random bottom trawl survey was carried out off West Greenland. The aim of the survey was to estimate stock sizes of groundfishes and to obtain information on distribution, size composition and biology of Greenland halibut (*Reinhardtius hippoglossoides)*, beaked redfish (*Sebastes mentella*) and roundnose grenadier (*Coryphaenoides rupestris*) on the continental slope between Div. 1A (south of 70 deg N) and 1D.

Yokawa, K., Kouya, I., and Jørgensen, O. 1996. Results of a stratified random bottom trawl survey off West Greenland in 1995. NAFO SCR documents 96/29: 12 p.

Since 1987 Japan Marine Fishery Resource Research Center (JAMARC) and Greenland Fisheries Research Institute (GFRI) have conducted cooperative trawl surveys off West and East Greenland. In 1995 one stratified random bottom trawl survey was carried out off West Greenland. The aim of the survey was to estimate stock sizes of groundfishes and to obtain information on distribution, size composition and biology of Greenland halibut (*Reinhardtius hippoglossoides)*, beaked redfish (*Sebastes mentella*) and roundnose grenadier (*Coryphaenoides rupestris*) on the continental slope between Div. 1A (south of 70 deg N) and 1D.

Zaferman, M.L. and Tarasova, G.P. 2004. Experiments on development of a method for Greenland halibut assessment with the use of underwater video. ICES CM 2004/R:01: 10 p.

The method is based on bottom trawl survey, for which fishing efficiency that is a relation between a number of fish caught and fish in the fished area was measured with the aid of underwater video. The method and devices (underwater video recorders) were developed and used in the experiments on fishing efficiency. The velocity and spatial orientation of G. halibut in the trawl estuary were measured analysing video records, and the concentrating factors by trawl doors and cables as well as trawl efficiency coefficient were calculated.

Zeller, D. and Freire, K. 2002. A preliminary North-East Atlantic marine ecosystem model: the Faroe Islands and ICES Area Vb. *In* The use of ecosystem models to investigate multispecies management strategies for capture fisheries. *Edited by* T.Pitcher and K.Cochrane. University of British Columbia, Fisheries Centre, Vancouver, B.C. pp. 39-45.

This report documents the construction and input data of the first Ecopath with Ecosim model for the Faroe Islands marine ecosystem in the Northeast Atlantic (ICES area Vb), covering the year 1997. The model comprises 19 functional groups, including two marine mammal groups and seabirds. The fisheries component consists of foreign fleets and national fleets, with an emphasis on demersal fisheries. Sustainable fisheries are of fundamental importance to the Faroe economy and culture. This model forms the foundation for future Ecosim and Ecospace simulations of the effect of fishing on the marine ecosystem around the Faroe Islands.

Zeller, D. and Reinert, J. 2004. Modelling spatial closures and fishing effort restrictions in the Faroe Islands marine ecosystem. Ecol. Model. 172: 403-420.

The Faroe Islands, located in the northeastern Atlantic Ocean, utilize a spatial- and effort-based system of fisheries management, explicitly incorporating ecosystem considerations in their policies. This management system was introduced relatively recently (mid-1990s). Given the importance of fishing to the Faroe economy and culture, considerable interest has been expressed in the evaluation of these new management measures at the ecosystem level. We used Ecopath with Ecosim to examine alternative management options for the Faroe Islands fisheries and compared these options with the status quo. Spatially explicit simulations were carried out using the Ecospace routine. Simulations suggest that current area closures could be considered beneficial in conserving major stocks of demersal species, with biomass for cod (*Gadus morhua*), haddock (*Melanogrammus aeglefinus*) and other demersal species increasing over the 10-year simulation period. Simulated removal of the closure system reduced the effect of the projected stock increases considerably. Greenland halibut (*Reinhardtius hippoglossoides*), one of the major deep-water species, and blue whiting (*Micromesistius poutassou)*, one of the main pelagic species, did not benefit from the existing spatial management. Simulated additional offshore closures of at least 20% of habitats deeper than 200m benefited Greenland halibut only. Both, Greenland halibut and blue whiting stocks benefited from drastic reductions in fishing effort (between 20 and 50% reductions from 1997 effort levels). Considerable uncertainty underlies the basic input data, which might have major consequences for the dynamic behaviour of the simulations, and thus might significantly alter the outcomes.

Zhivov, B. D. 2001. On the regulatory measures for Greenland halibut in the Barents Sea. Shevelev, M. and Lisovsky, S. eds. *In* 9th PINRO-IMR Symposium, Murmansk (Russia), Technical Regulations and By-Catch Criteria in the Barents Sea Fisheries. *Edited by* Shevelev, M. and Lisovsky, S. PINRO, Murmansk (Russia). pp. 184-188.

The paper in brief presents results from the investigations on Greenland halibut *Reinhardtius hippoglossoides* (Walbaum) from the Norwegian-Barents Sea population. The investigations were carried out by the vessels of ZAO NPP "Vega" in 1996-2000. In the course of the specialized investigations, including the monitoring of aggregations on the all-the-year-round basis, assessment trawl and fry surveys, the investigations using autonomous video recorder, the data on biological and fishing characteristics of halibut aggregations were obtained. Results of the investigations, as well as the data from surveys and experimental works, have indicated that a ban on trawl fishery had a general positive effect on the status of the Greenland halibut population. Commercial and spawning stocks increased to 120,000 and 89,000 tonnes, respectively. Positive variations in the stock structure, growth of biomass of older fish, as well as increase in the density of aggregations, are noted. Along with this, a directed fishery for halibut with passive fishing gears is continued, due to which larger fish are removed, that adversely influences the growth rates of the spawning stock.

Zilanov, V.K. 1987. Some problems of optimum utilization and management of grenadier and halibut stocks in the northwest Atlantic and in the conditions of 200-mile zones. NAFO SCR documents 87/96: 6 p.

Zilanov, V.K., Strogonov, A.A., Troyanovsky, F.M., and Chumakov, A.K. 1976. The results of the study of commercial reserve of Greenland halibut (*Reinhardtius hippoglossoides*) at the continental slope in the North-Western Atlantic. ICNAF Res. Doc. 76/VI/109: 20 p.

Zilanov, V.K., Kudrin, B.D., Luka, G.I., Ponomarenko, V.P., and Troyanovsky, F.M. 2004. Otkrytie i promyshlennoe osvoenie novykh rajonov i ob"ektov rybolovstva v Severnoj Atlantike v 1960-1970 [Development of new fisheries in the North Atlantic in the 1960s-1970s]. PINRO, Murmansk (Russia). 162 p.
[In Russian, English summary]

The history and results of national research and development of fisheries of deep-sea species, as well as resources on the continental slope and in pelagic waters outside the shelf in the North Atlantic to 1974 are presented. A scientific exploratory fishing was complemented by collection of biological and hydrographic data, studies of fish behavior and their response to physical impacts, as well as by development of new fishing techniques. Scientific knowledge was used as a basis for searching perspective fishing areas and target species (Greenland halibut *Reinhardtius hippoglossoides*, witch flounder *Glyptocephalus cynoglossus*, roundnose grenadier *Coryphaenoides rupestris*, Atlantic saury *Scomberesox saurus*, capelin *Mallotus villosus*, polar cod *Boreogadus saida*), and their further commercial exploitation by fishing fleets ensured sustainable development of fisheries in the USSR in the end of the last century.

Zubchenko, A.V. 1980. Parasitic fauna of Anarhichadidae and Pleuronectidae families of fish in the Northwest Atlantic. Int. Comm. Northwest Atl.Fish. Sel. Pap. 6: 41-46.

Examination of wolf fish (15 *Anarhichas lupus* and 12 *A. minor*) and flatfish (20 *Reinhardtius hippoglossoides*, 10 *Hippoglossus hippoglossus*, 27 *Hippoglossoides platessoides* and 15 *Glyptocephalus cynoglossus*) during 1975 to 1978 from the Northwest Atlantic revealed 47 species of parasites, of which only 7 were common to the 2 host families. There were 6 species of Myxosporidia, 4 of Cestoda, 24 of Trematoda, 6 of Nematoda, 2 of Acanthocephala, one of Hirudinea and 4 of Crustacea. 14 species were found in *A. lupus* and 11 in *A. minor*, 8 species being common to both hosts. However, *Fellodistomum fellis*, present in 67% of *A. lupus*, was not found in *A. minor* and *Diphtherostomum microacetabulum*, present in 42% of *A. minor* (at high infection intensities) was not found in *A. lupus*. The parasite fauna of *A. minor* consisted largely of parasites specific for Anarhichadidae, whereas *A. lupus* had a greater variety of non-specific parasites. Differences among the parasites of the 4 species of Pleuronectidae are also discussed and related to differences in host ecology.

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